ENGINEERING

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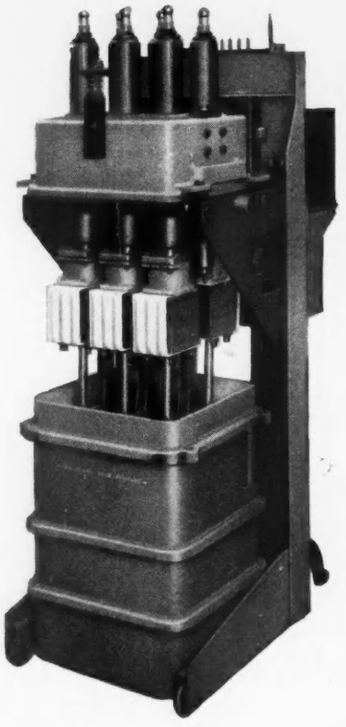

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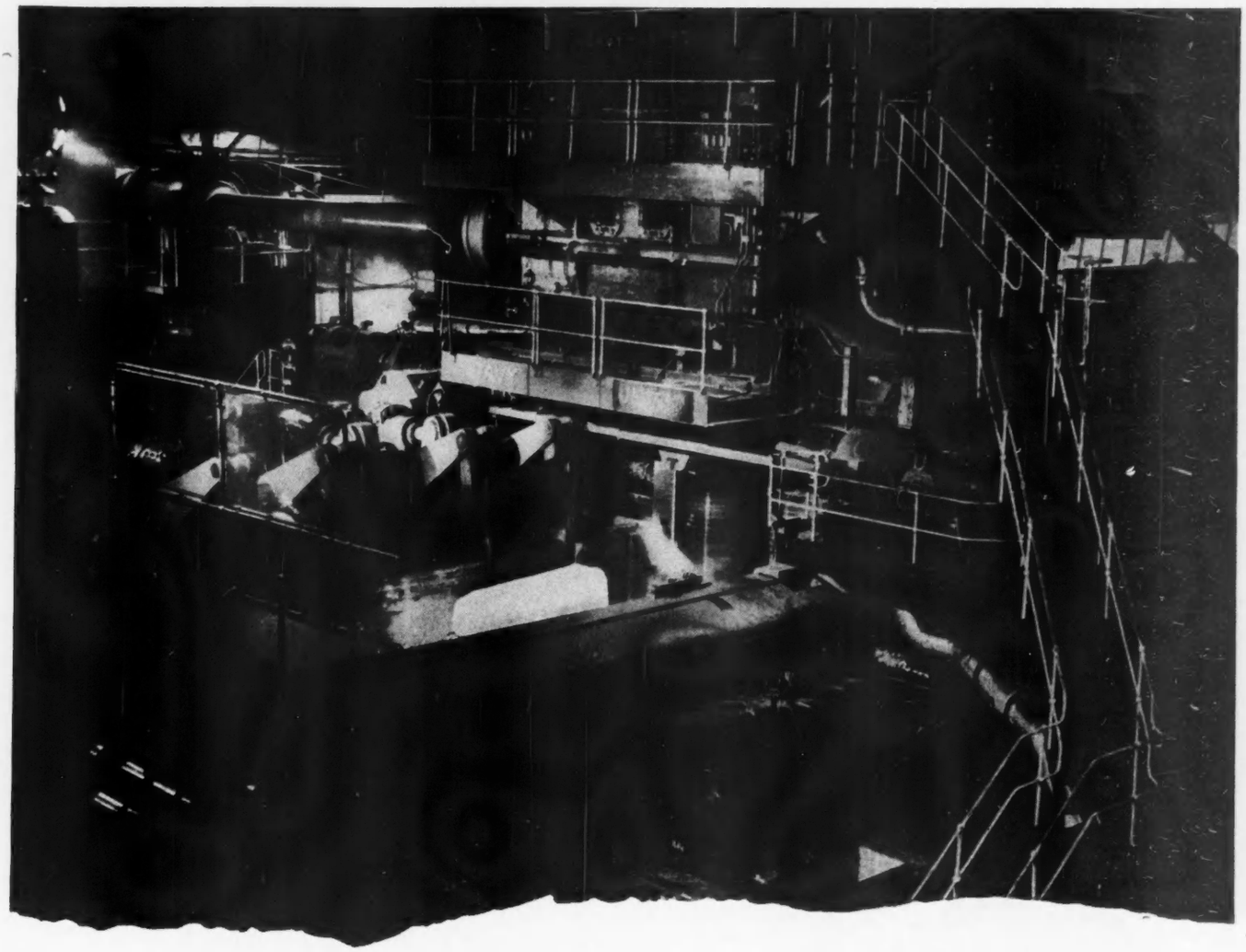

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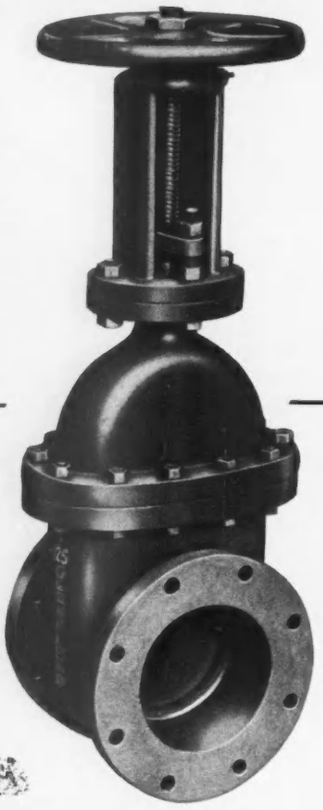

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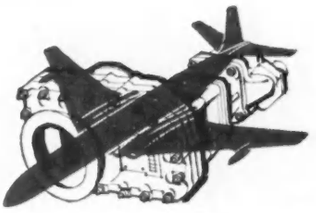

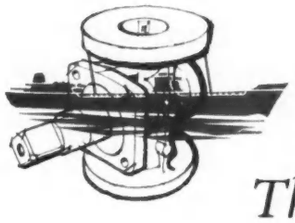

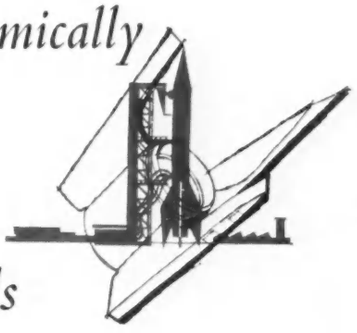

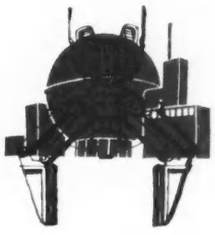

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Milling the feet and block face simultaneously on a single cylinder crankcase. An automatic cycle duplex milling machine with an air fixture is being used. After milling the crankcase passes to a transfer unit which automatically turns it through 90° and stands it on its feet. *Nurnberg photograph for* ENGINEERING.)

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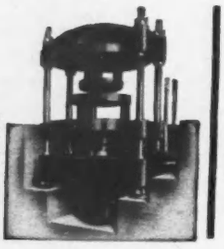

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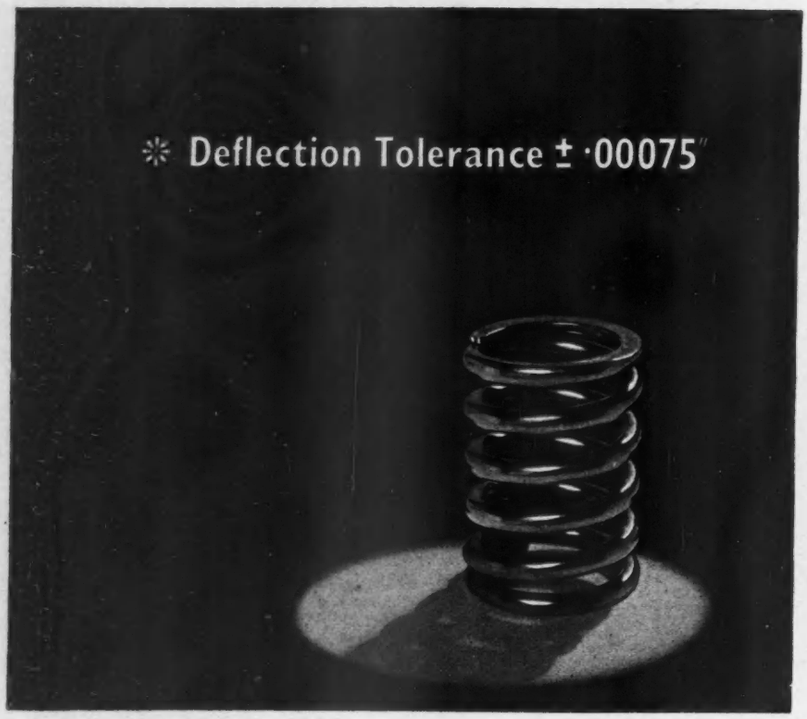

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(3) Tenders in duplicate must be submitted in sealed envelopes addressed to: The Chairman, Board of Management for the Port of Rangoon, Post Box No. 1, Rangoon, Burma, and marked "Tender for Wharf Cranes." Tenders must reach the above office not later than 12 noon on 7th January, 1961, or be posted to the above mentioned address sufficiently early to arrive on or before the appointed time and date.

(4) The Board does not bind itself to accept the lowest priced or any tender or to assign any reasons for rejection of any tender.

WIN PE,
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Please quote the above reference number. D 47

THE PROPRIETORS OF BRITISH PATENT NO. 758519 for "AN IMPROVED MULTI-STAGE SELF-PRIMING CENTRIFUGAL PUMP," desire to enter into negotiations with a firm or firms for the sale of the patent or for the grant of licences thereunder.—Further particulars may be obtained from MARKS & CLERK, 57 and 58, Lincoln's Inn Fields, London, W.C.2. D 57

THE PROPRIETORS OF PATENT NO. 779503 for "Improvements in and relating to Exhaust Piping for Multi-Cylinder Internal Combustion Engines," desire to secure commercial exploitation by Licence or otherwise in the United Kingdom.—Replies to Hasceltine Lake & Co., 28, Southampton Buildings, Chancery Lane, London, W.C.2. D 41

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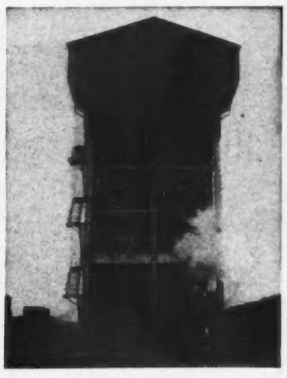

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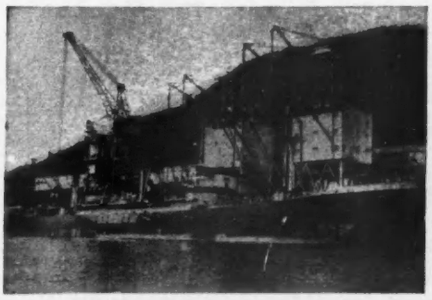

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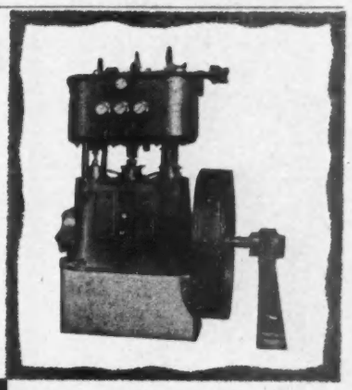

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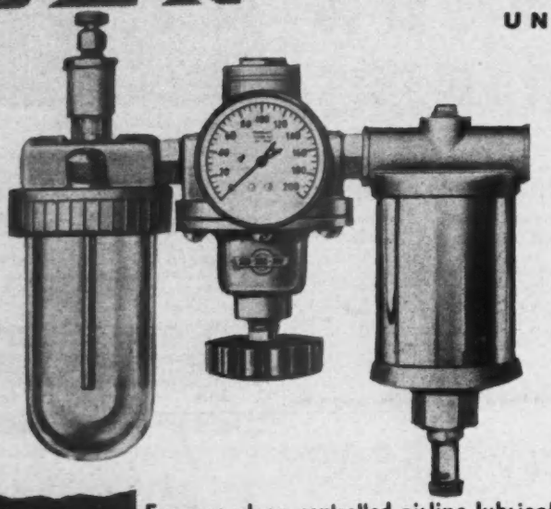

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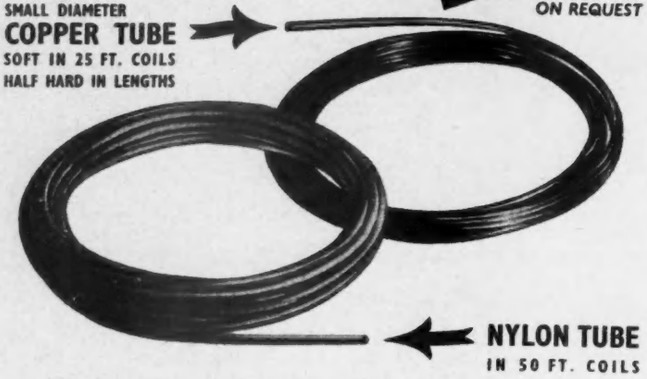

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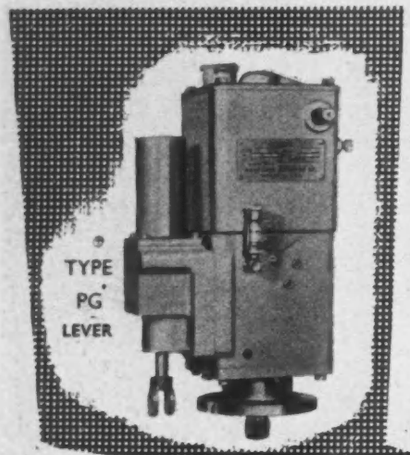
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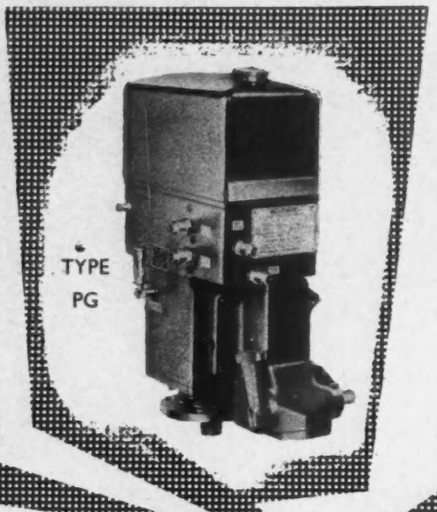
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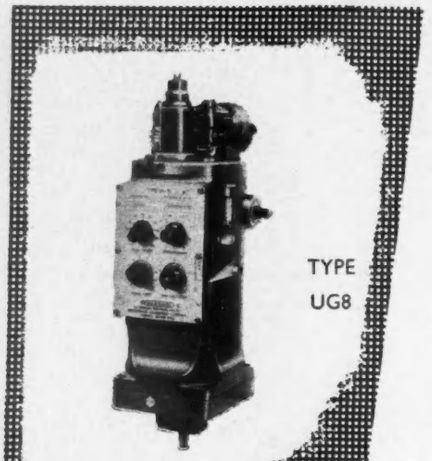
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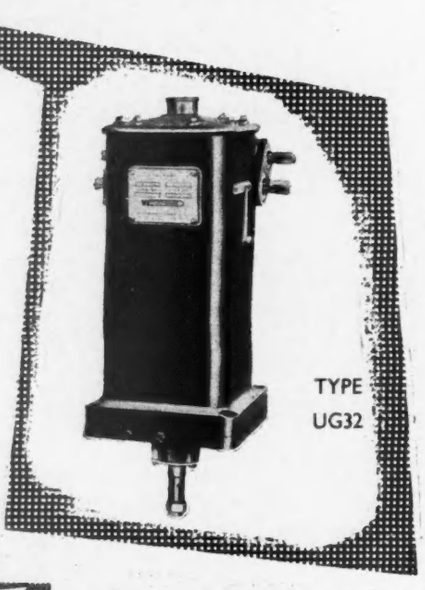
TYPE UG32

RATED WORK CAPACITY		TYPE SPEED ADJUSTMENT
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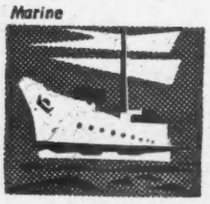
PSG	2.6 ft./lb.	MANUAL, LEVER OR ELECTRIC
LSG	1 or 10 ft./lb.	MANUAL OR ELECTRIC
UG8	8 ft./lb.	MANUAL, LEVER OR ELECTRIC
UG32	32 or 40 ft./lb.	MANUAL, LEVER OR ELECTRIC
PG	12/18 or 35 ft./lb.	MANUAL, LEVER OR ELECTRIC
PG for RR	12 or 35 ft./lb.	ELECTRIC OR PNEUMATIC
PGPL	12/18 or 35 ft./lb.	MANUAL AND PNEUMATIC OR ELECTRIC


Marine

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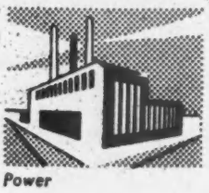
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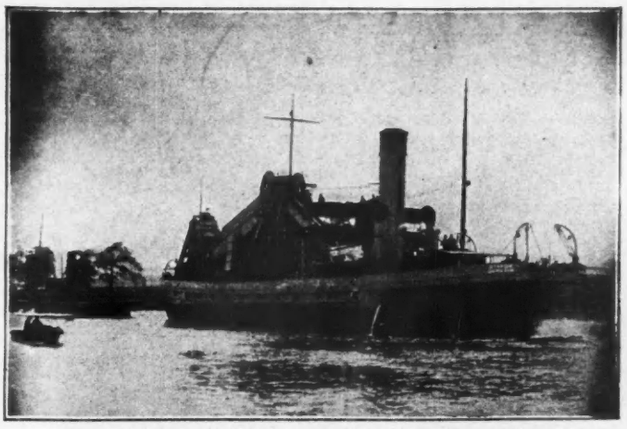

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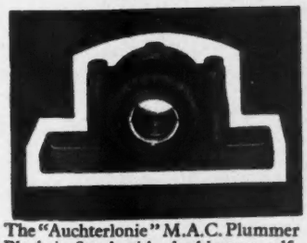

The "Auchterlonie" M.A.C. Plummer Block is fitted with double-row self-aligning adapter ball bearings.

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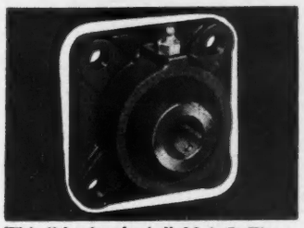
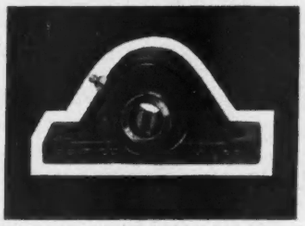


This "Auchterlonie" M.A.C. Flange Unit is a noteworthy advance in design. It is easily mounted, completely sealed to retain lubricant and exclude dust, and incorporates standard double-row, self-aligning ball bearings.



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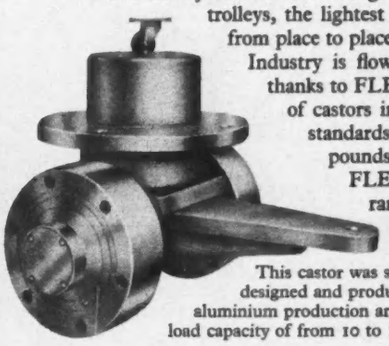

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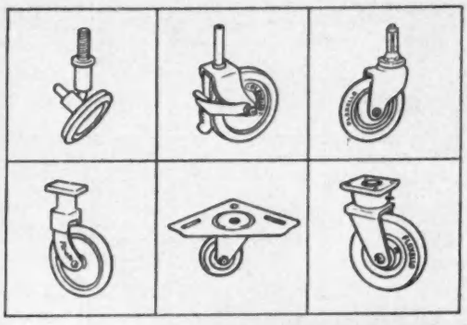

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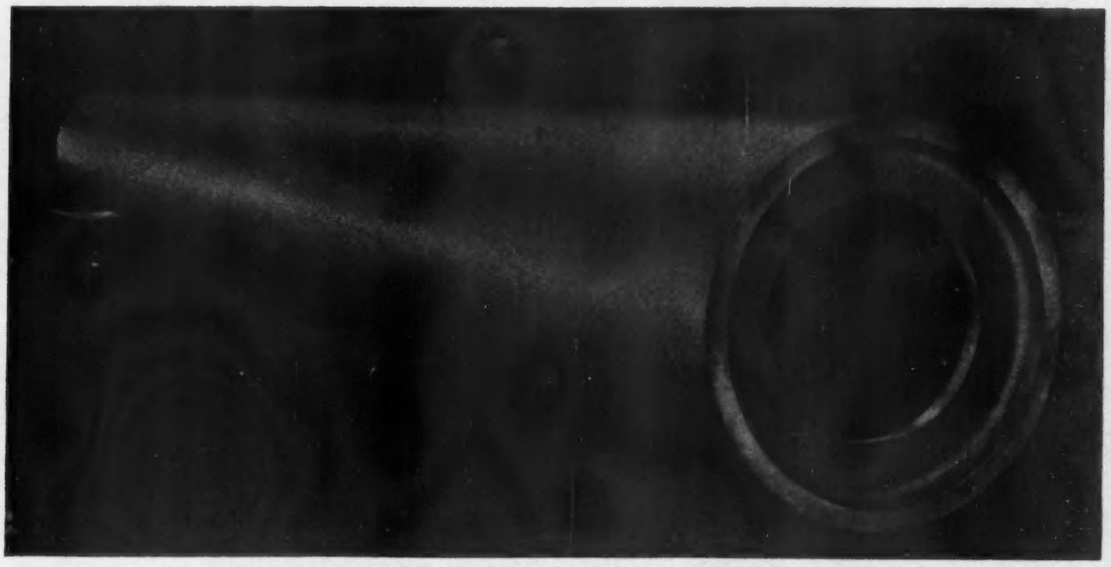

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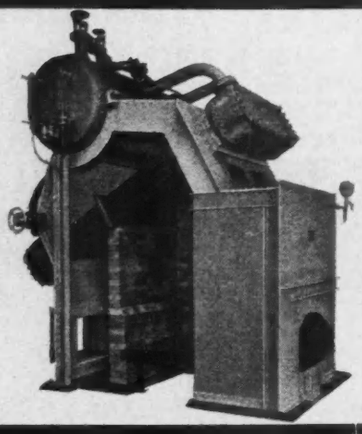

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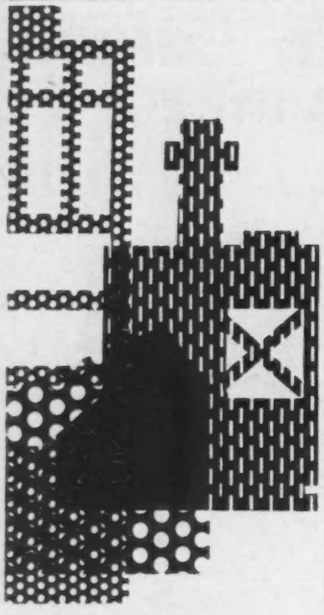

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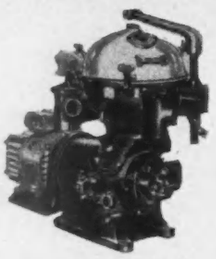

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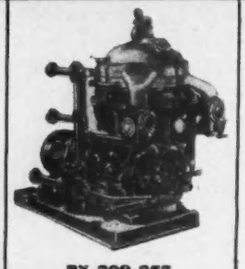

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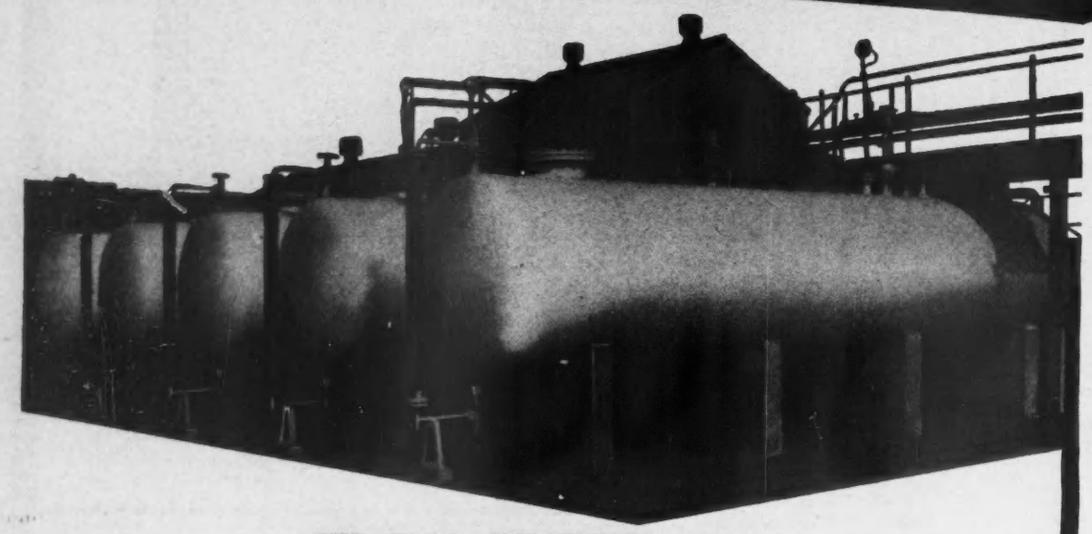

5—Horizontal Pressure Vessels. Dimensions 27′ 3½″ long × 6′ 0″ diameter. Shell ⅝″, Ends 1″ thick. Test Pressure 225 lbs. per sq. inch. A sixth vessel was supplied recently. Illustration by courtesy of National Smelting Company Ltd., Avonmouth.

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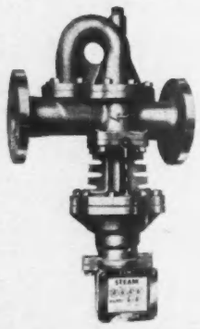

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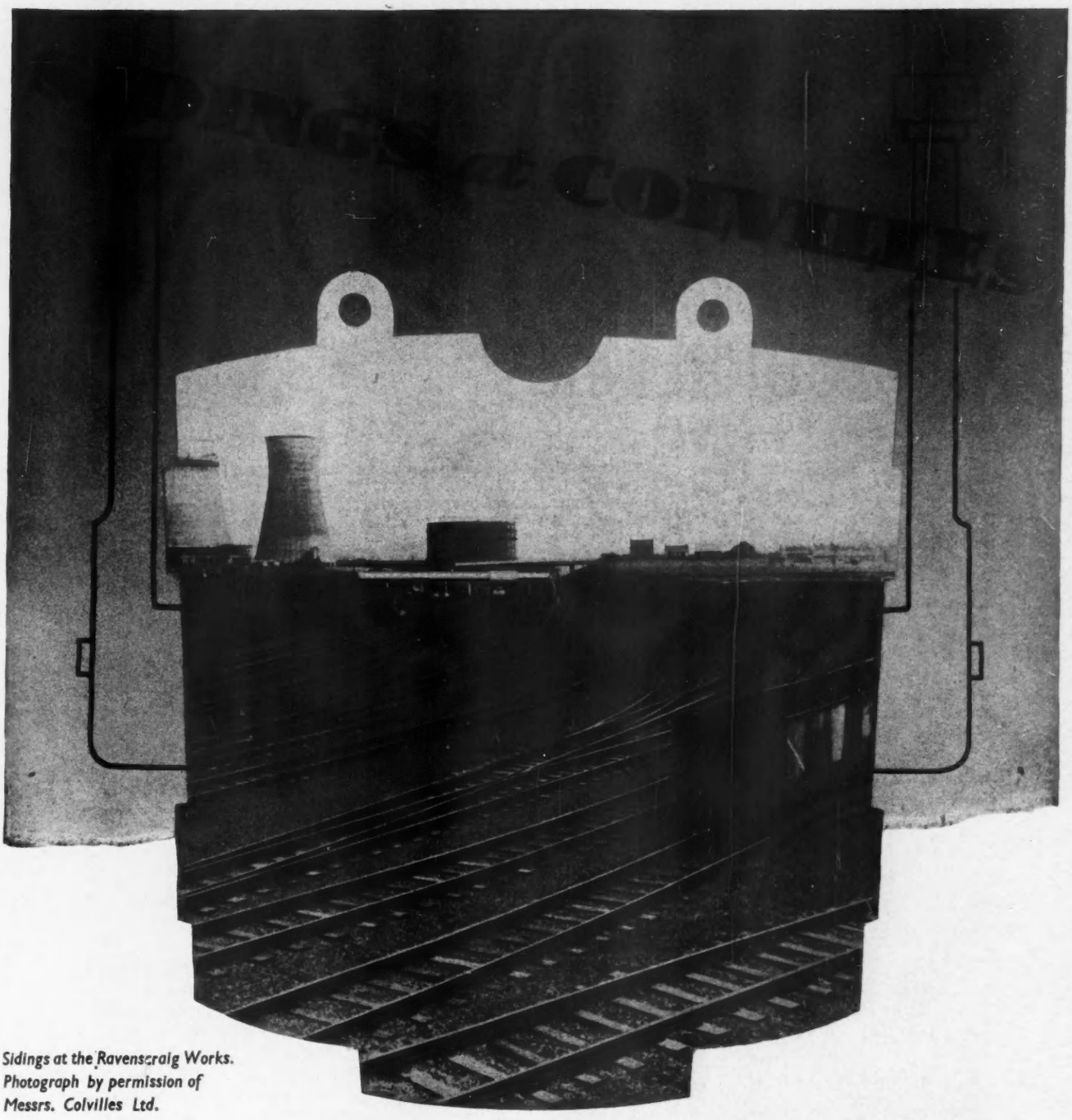

Sidings at the Ravenscraig Works. Photograph by permission of Messrs. Colvilles Ltd.

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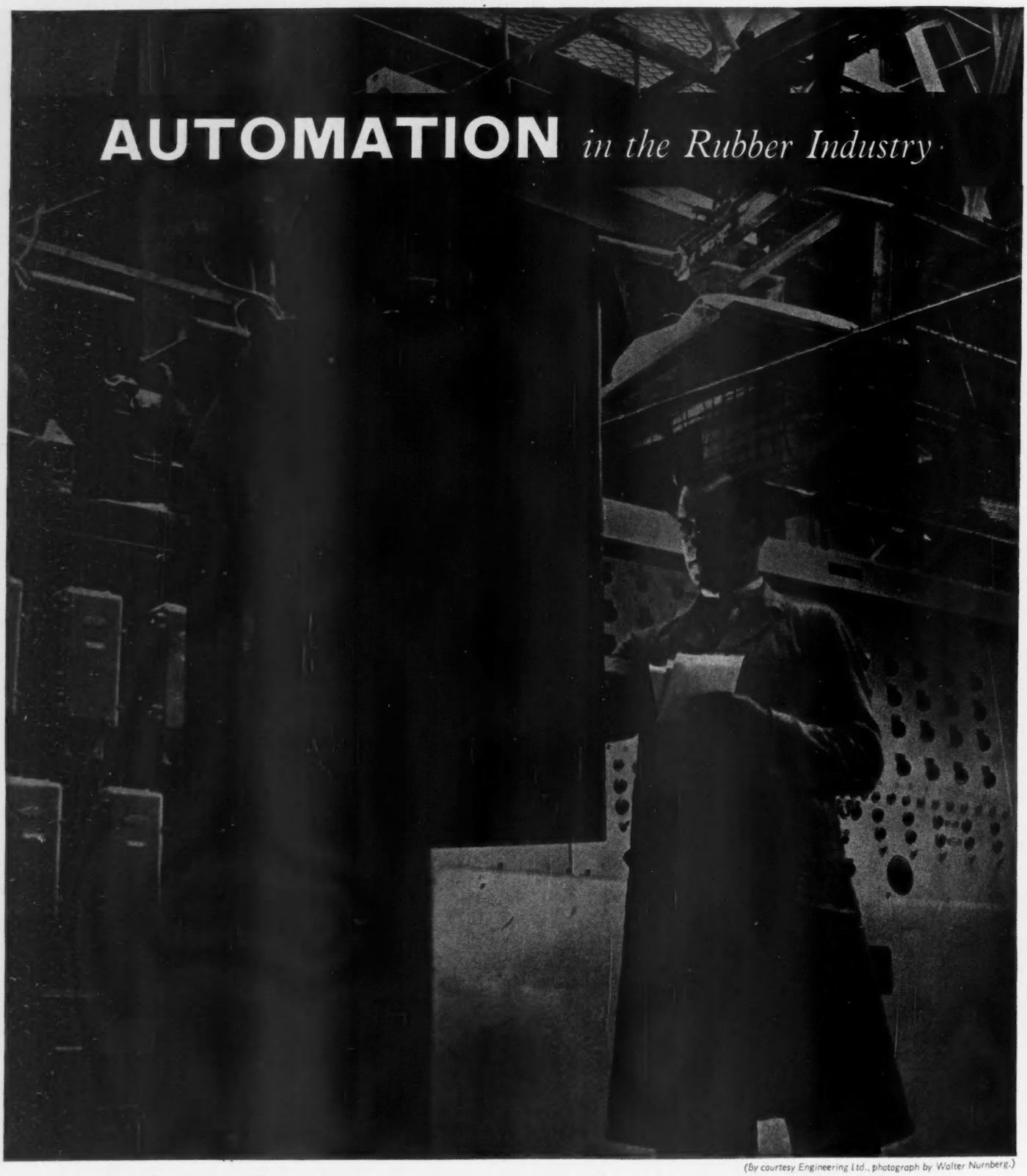

(By courtesy Engineering Ltd., photograph by Walter Nurnberg.)

Setting up a formulation in an automatic plant for compounding rubber

Rigid specifications and the concise requirements demanded by modern industry, call in turn for great accuracy in the compounding of rubber mixes. Here the operator at the control panel of the first automatic rubber compounding plant in operation in the British Isles, is seen determining the necessary ingredients and quantities, so as to ensure this accuracy. Thereafter the various silos situated above automatically release the required amounts into hoppers which then move into the rubber mill.

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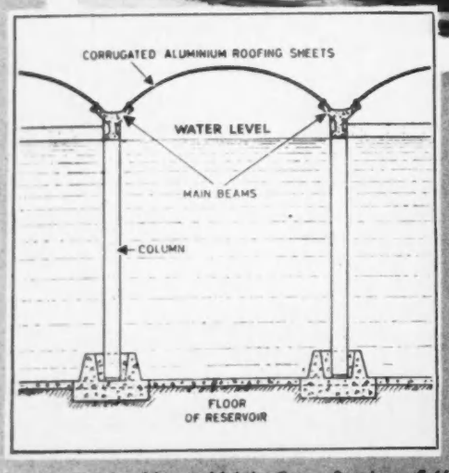

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MOBILE CRANES

The Morris 6 ton mobile cranes illustrated, are erecting the columns and the main beams which will support the aluminium sheet roof of a 16 million gallon concrete lined reservoir now being constructed at Weeton, Lancs., for the Fylde Water Board. Each crane has a 35ft. jib made up of two 15ft. sections and one 5ft. centre section.

The cranes lend themselves admirably to a somewhat unusual situation involving partial dismantling, so that they can be passed through an 8ft. wide culvert leading to the floor of the reservoir basin where they are seen operating. Although, in this instance, the cranes are shown fitted with strut jibs, the Morris range of mobiles embraces cranes with cantilever jibs, truck and lorry mounted types up to 6 tons capacity in addition to similar alternative range for loads up to 3 tons.

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ENGINEERING
22 30 September 1960

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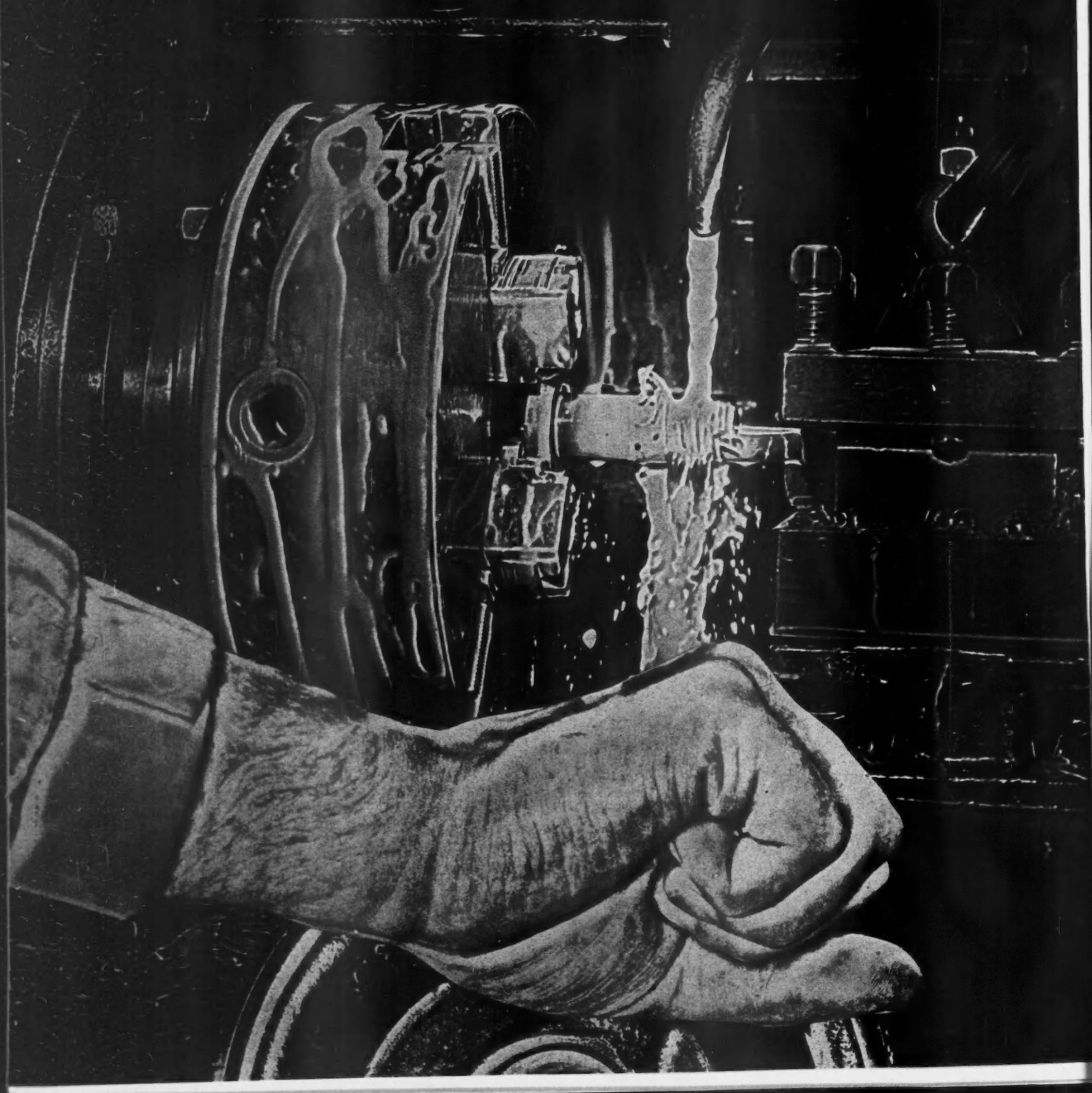


With new Shell Dromus Oils

Most modern soluble cutting oils contain phenolic compounds used as coupling agents between the oil and the emulsifier, for better blending and easier mixing. These phenolic compounds can cause skin irritation, especially where modern high-speed machines are used and the emulsion can concentrate, through the evaporation of water, above the safety level.

Shell research chemists have been working on this problem, which has been causing some concern to Management. After considerable research, Shell Dromus Oils have been reformulated and these new cutting oils now produce bland emulsions, which considerably reduce the risk of skin trouble to operators.

The real difficulty was to find a new coupling agent to replace the phenolic compounds, and Shell finally used what their chemists know as a higher fatty alcohol complex. This solved one problem, but presented another. The new coupling agent was volatile at the high temperatures normally used in blending processes. Further research found a solution to this problem by designing and installing new plant. The new Dromus Oils are every bit as efficient as before and cost no more. They put Management in the welcome position of being able to minimise working hazards at no extra cost. And machine men need no longer be so worried about skin troubles.

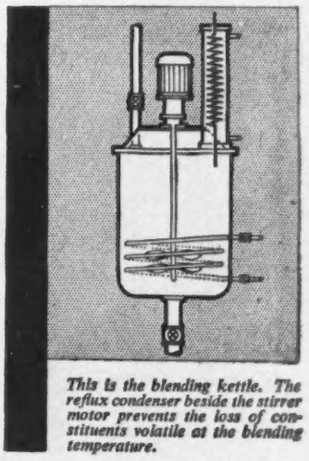
The moral of the story is that Shell research is supremely applicational. The centre at Thornton is always ready to work with even the most specialised sectors of industry to produce the right oil for the job. If you and your organisation have any major lubricating problems, it pays to get in touch with your local supplier of Shell Industrial Lubricants.

The Research Story

Shell chemists in the U.K., in Holland and in the U.S.A., prepared and examined hundreds of experimental soluble oils, and established that certain combinations of fatty alcohols could be used in place of phenolic compounds with no loss of efficiency. They set to work to discover the best combination and developed a higher fatty alcohol complex which fitted exactly. Then they realised that to blend this new coupling agent into soluble oils would require special plant and new blending techniques.

Exhaustive testing of blend stability, emulsion stability, anti-corrosion and machining properties led to selection of the most promising blends. A pilot plant was set up to produce batches of these for use in field trials.

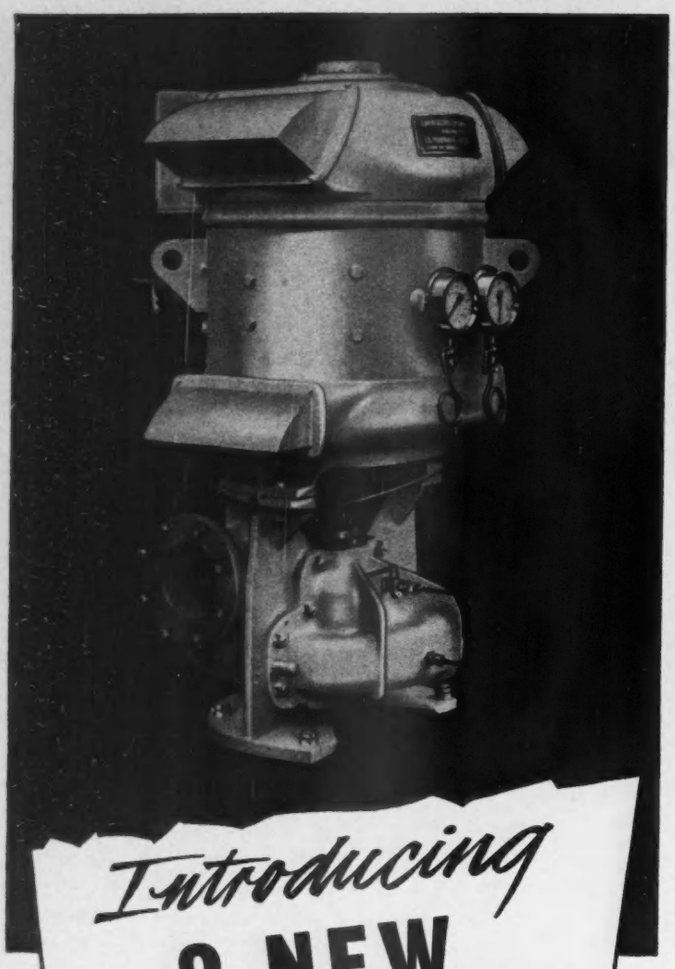
This field testing and final development proceeded for two years whilst production plants were erected at points so chosen as to give the most economical and rapid delivery throughout the United Kingdom.



This is the blending kettle. The reflux condenser beside the stirrer motor prevents the loss of constituents volatile at the blending temperature.

NEW SHELL DROMUS SOLUBLE CUTTING OILS

another proof of Shell leadership in lubrication



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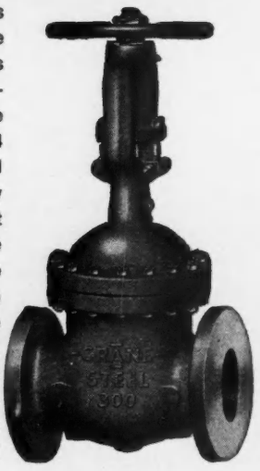

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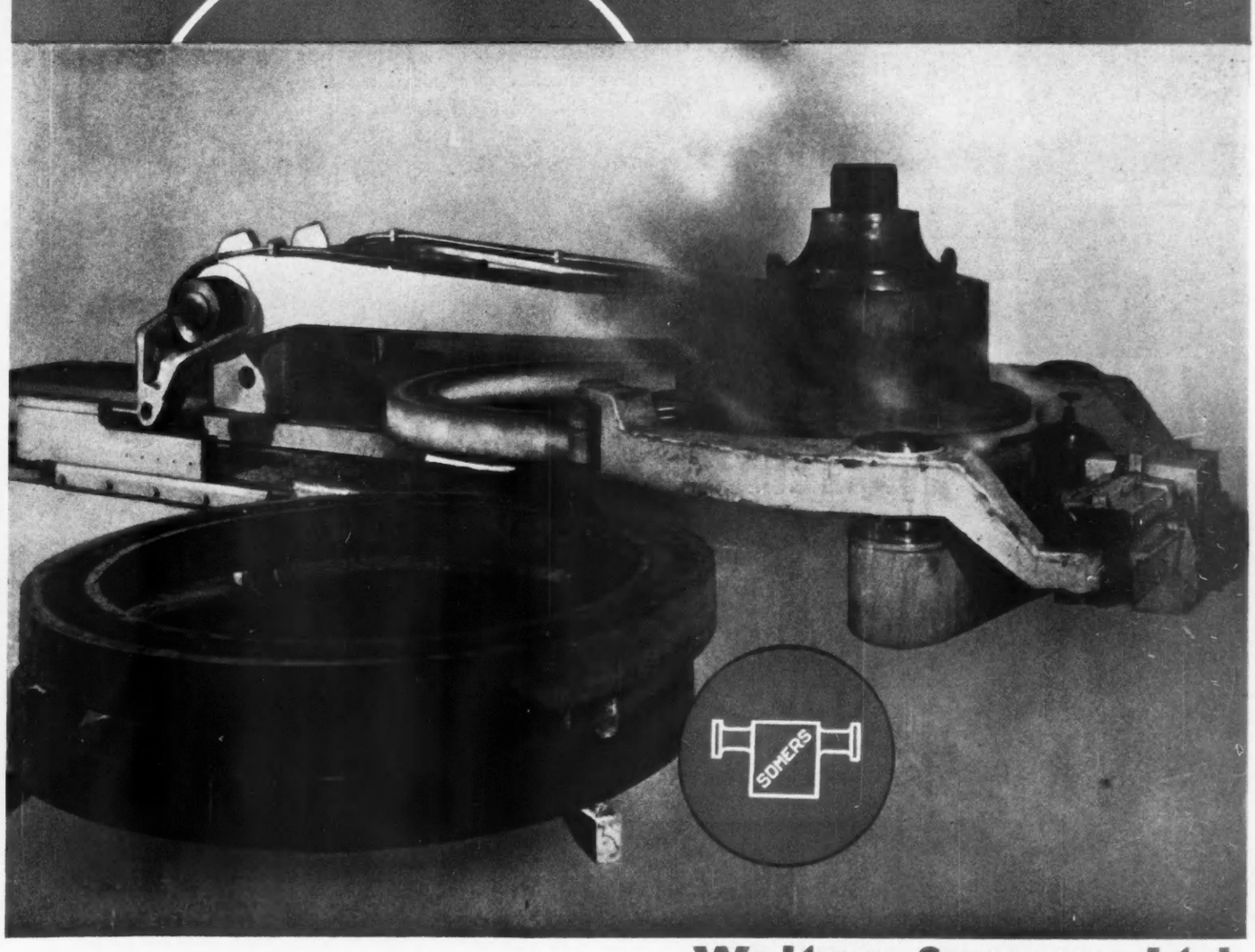

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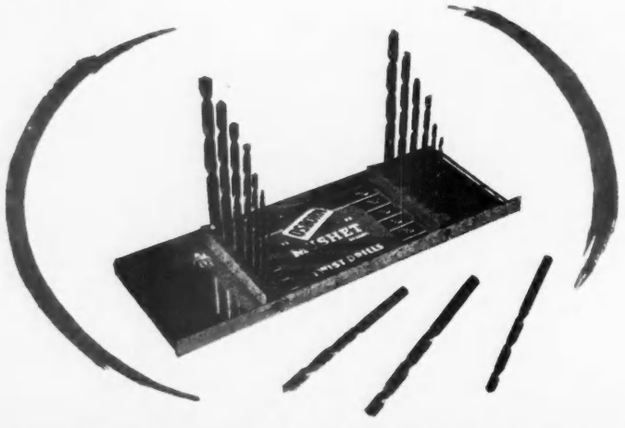

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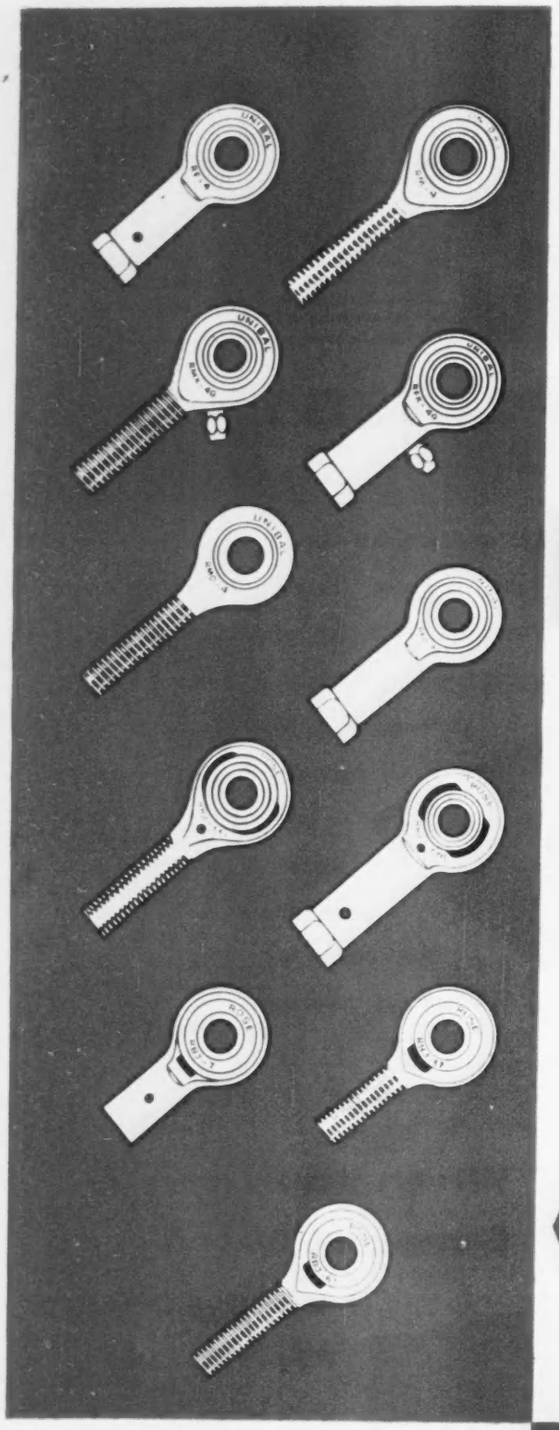

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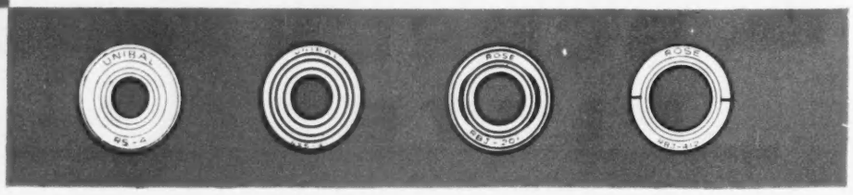

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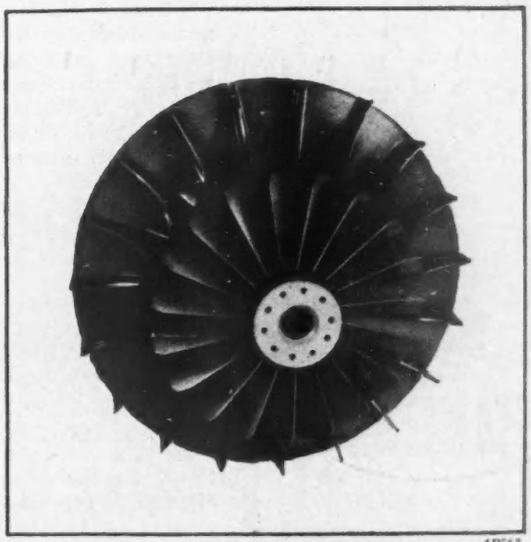

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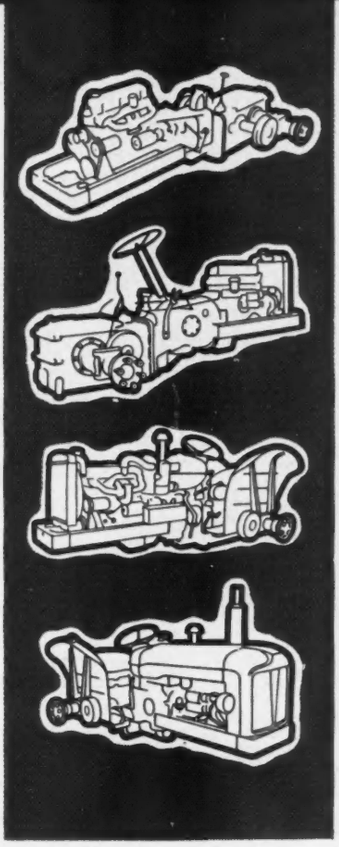

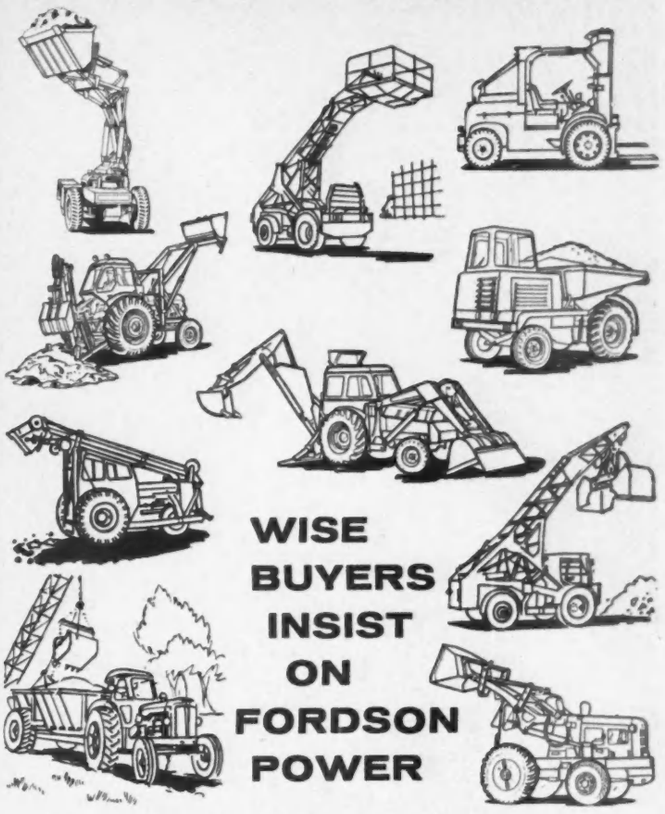

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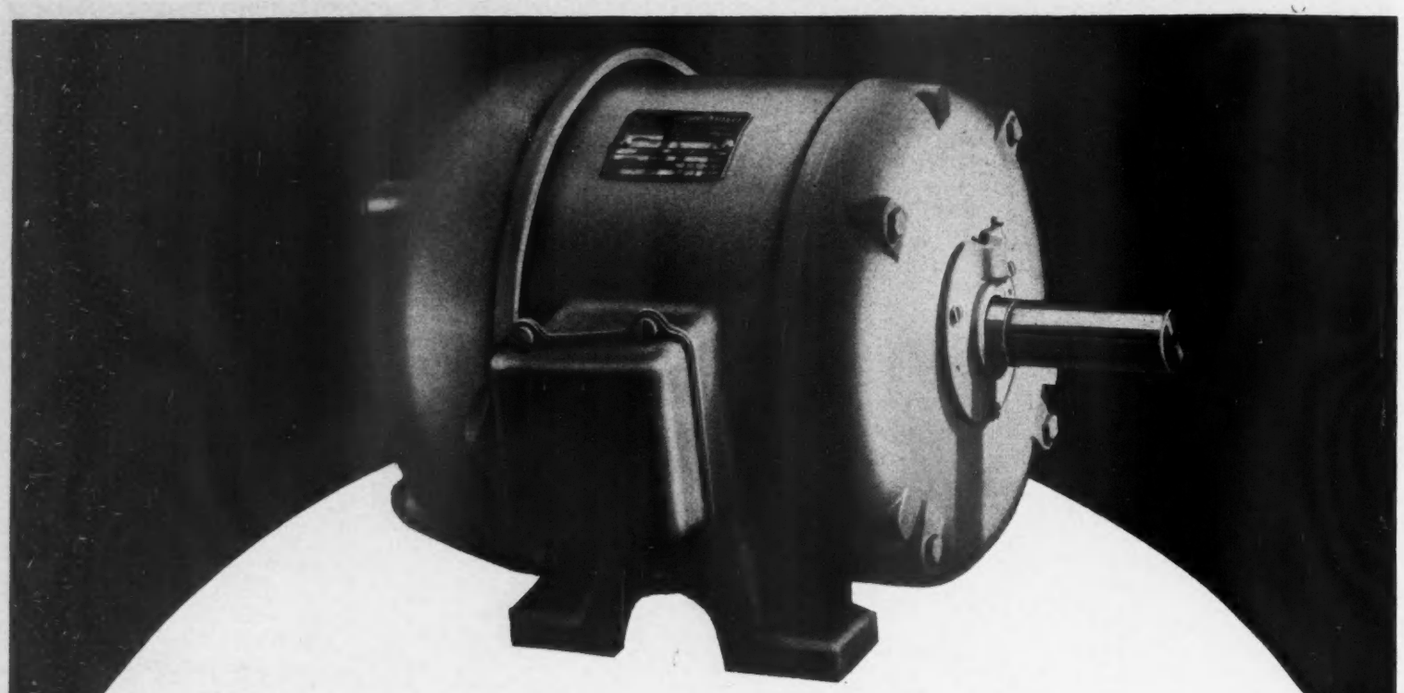

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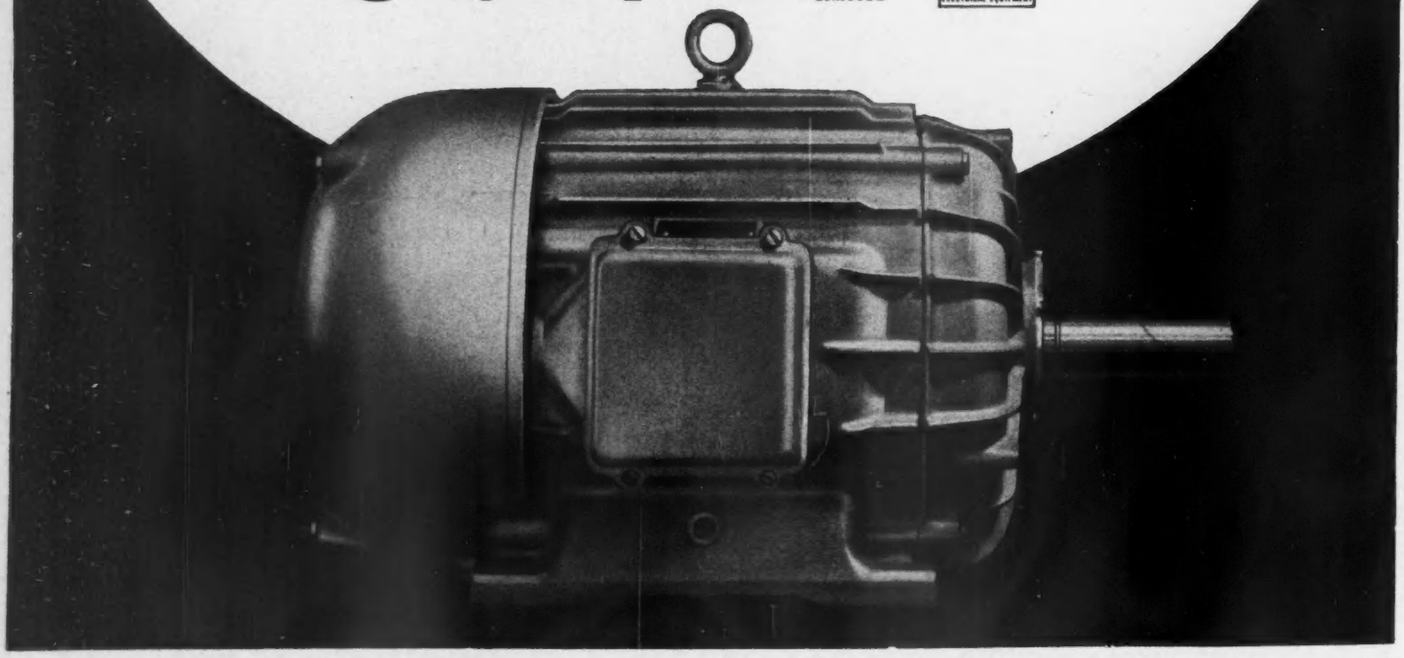

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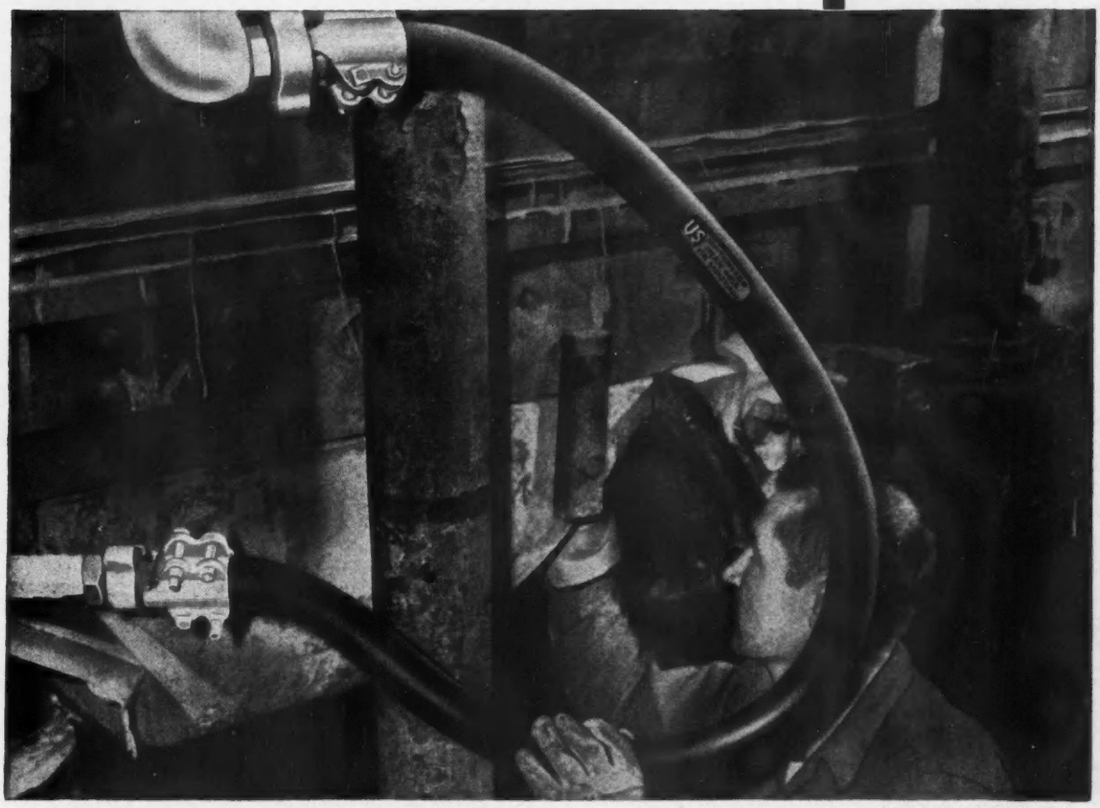

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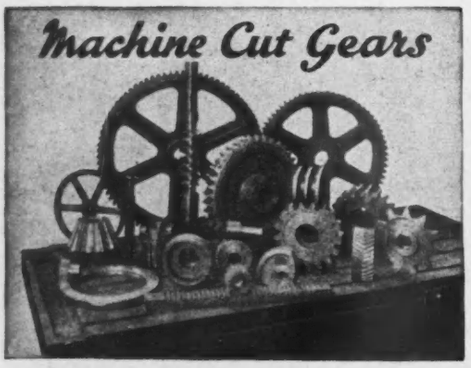

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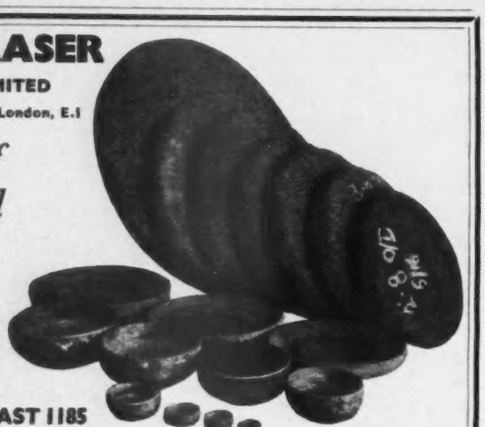

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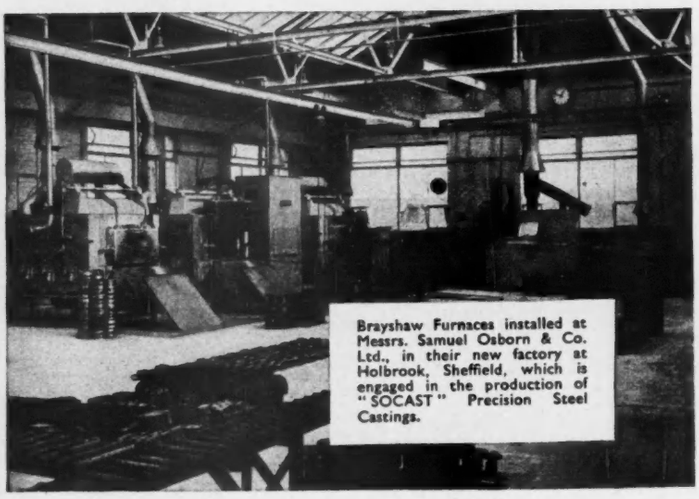

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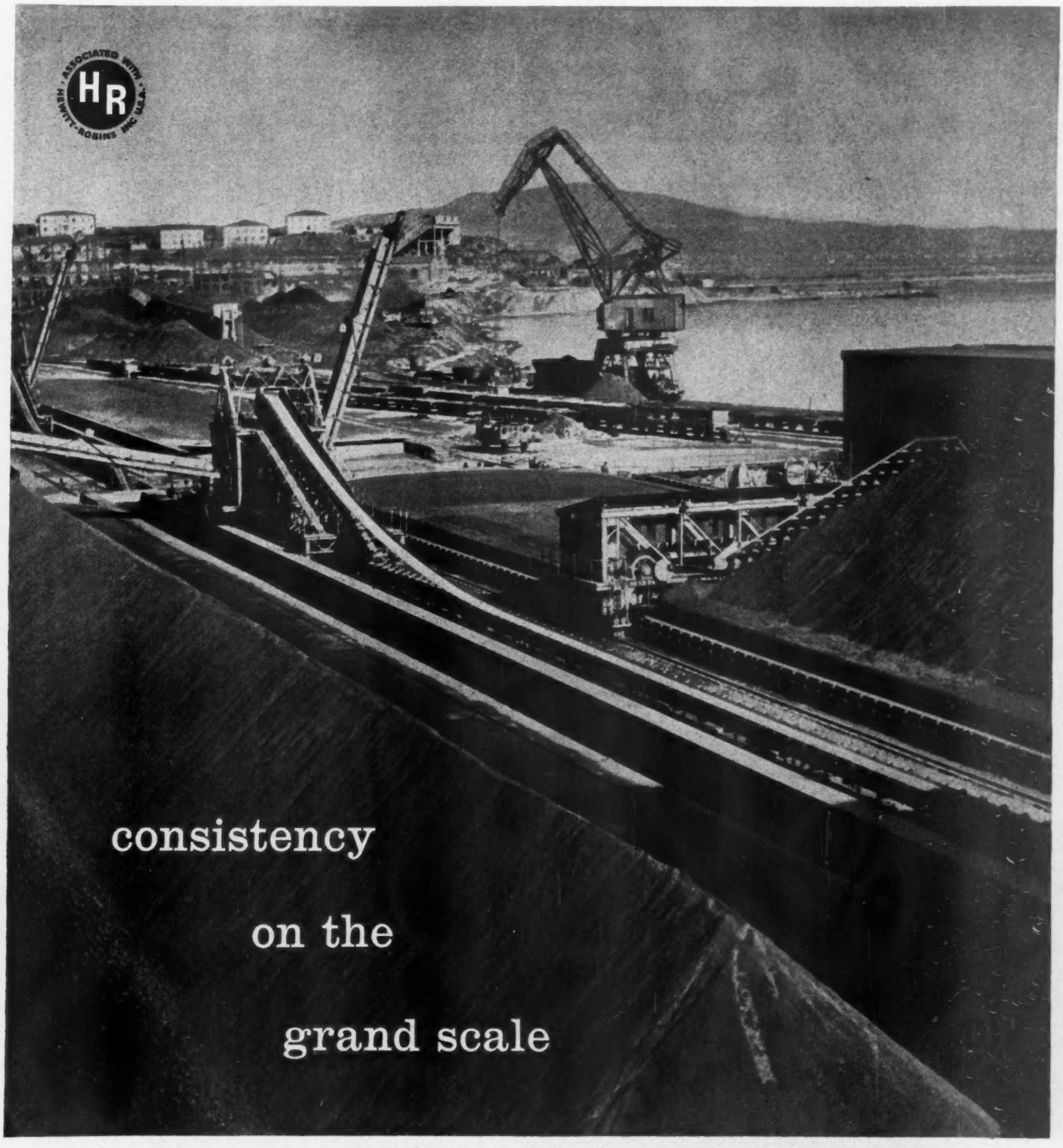

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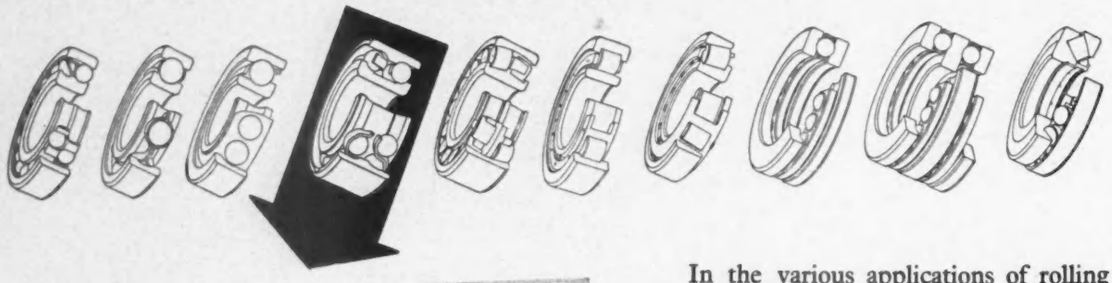

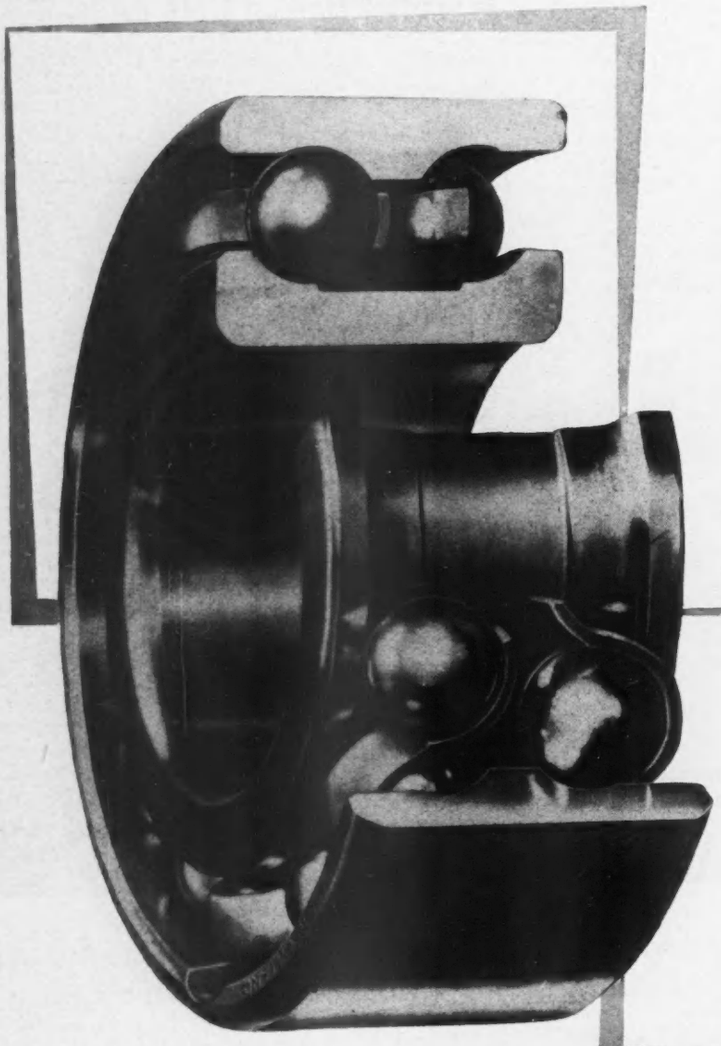

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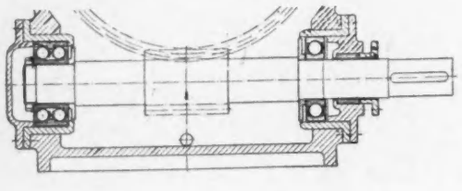

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ENGINEERING Impact

Of Independence on African Industry

UP TO the day of independence nationalist politicians are under pressure to obtain self-government. But from the first light of that day the pressure comes from another direction. The demand becomes more and more insistent that living standards in the new state shall rise.

In an independent state, with its own delegation at the United Nations, the difference between Western European and United States living standards and those of, say, Africa, is a constant thorn in the flesh.

From 1 October this is how it is going to be in Nigeria. And there is some evidence that even faster than appears likely in Ghana the Nigerians will steadily push up the national income, now only £30 a head per year, raising factories and exploiting mineral resources with the gusto that went in simpler times into demanding the control of their own affairs.

The proposals to double the capacity of the Tunnel Portland Cement Works, at Nkalagu, by a date not three years from the starting up of production, is some sign of the speed at which development may go. Electricity demands, moreover, are increasing at a rate above 20 per cent per annum.

Nigeria has taken the customary steps that guarantee a period of tax-free settling in, its political speeches are free of the cold-water effect of yearnings to nationalise foreign owned concerns, and there is no capital gains tax but labour is if anything far too cheap, and the other side of this penny is too little purchasing power—at either personal or government level.

Two Lessons from the Car Companies' Dilemma

Down and down go the figures of motor car production. And with them slide the earnings of the men in the car firms.

The shadow stretches across the path of the car firms from a question mark which, twelve months ago, only the habitually pessimistic cared to raise. It is the question of where the market is to be found for the potential output of all the new car capacity planned not only for the United Kingdom car companies but those of the European Common Market manufacturers, the Japanese, and in the background the immense potential of Detroit. It is also just as well to remember the growing output capacity of General Motors-Holden in Australia and the possibilities of subsidiaries set up by enterprising European firms in the Latin American countries.

The answer, or part of it, comes from the British motor industry itself, and also from overseas. Exports of British trucks go from strength to strength. Seemingly almost every day the celebrated Lancashire truck firm, Leyland, announces a new and important foreign order. American transport operators are buying their first Leylands, on grounds of reliability and performance, just as their purchases of foreign saloons are slipping badly.

To want a totally free home market, with imports of steel and pressure on the pound, is indirectly to court a situation where unavoidable changes in the value of sterling could make the last position worse than the first.

There is not a lot of comfort in the second lesson but it is one worth studying. In Brazil the Volkswagenwerk company has facilities for the assembly of its cars and trucks. The Brazilian Government requires a rising proportion of locally made components.

Other governments do the same or will do so. Pressed to find employment for their peoples, to set about industrialising the country, more and more countries will favour the local subsidiary assembling imported parts with some local production, against the import ready to drive off from the docks.

Doing it this way is not to get the whole of the cake but it is to retain a sizeable slice of it.

The Most Expensive Car Crash

When engineers carry out the final post mortem on Donald Campbell's Bluebird car after it arrives back in this country, the decision will be taken as to how much of the car is fit for re-use. At any rate it seems certain that Bluebird as a project will go on; and this means that the many firms concerned will once again have to redouble their efforts to get the car running by next summer.

What lessons if any are to be learnt from Bluebird's accident? Obviously a speed record attempt of this kind is fraught with unknown factors, but in view of the risk to the life of the driver, not to mention the vast sum of money already swallowed up in the attempt, can something not be done to increase the safety and hence the chance of success?

Thanks to the Didas instrument telemetering system, which provided invaluable data up to the crash, it was established that Bluebird had reached a speed in the neighbourhood of 350 m.p.h. when the accident occurred. Furthermore, this speed was achieved only 1·6 miles from the start, which is some indication of the torque characteristic of the Proteus engine. Unfortunately the surface of the Salt Flats is of varying character, and at the point where the accident occurred, the salt was unable to stand the terrific acceleration without yielding. Once wheelslip started it became progressively worse until the car went into a skid from which it could not recover.

For the record attempt a course 11 miles long and about 30 yards wide was prepared, all the loose salt being brushed off, a task of considerable magnitude. At Bluebird's speed, however, it must have been very hard for Campbell to keep within the black oil lines which define the course, and yet to deviate from them meant almost certain disaster. The oil softens the salt along each line and Bluebird was running with two wheels along one line when the skid started. Even the prescribed course was irregular and softer in some places than others. Apart from making the course wider next time, one wonders whether some marker system might not be employed to indicate to Campbell where it is advisable to ease off the throttle for a moment.

Certainly it would seem worthwhile considering what steps might be taken to eliminate some of the hazards of the course, otherwise next time the post mortem might not be on Bluebird alone.

of a 15th Storey Room With a View

Not even the new office blocks and the towering flats rise faster than the price of land. It is not necessary to quote figures from inner London or even the Home Counties. Towns that would be half a day's journey from the capital are finding their outlying acres worth money that two years ago would have bought useful pieces of the town centre.

It is the business of Governments to react to change and Mr. Henry Brooke, the Minister of Housing and Local Government, has reacted in this case. The Green Belts, integral parts of England's last hope of staying within reach of a "green and pleasant land," are not to be touched.

This throws the pressure back on urban dwellers, though among them there may be those who, harmlessly enough, had hoped to escape from change and retain the proportions of earlier, less populous times.

Elegantly designed, high tower blocks can enhance the scene, says Mr. Brooke. And he hits the centre of the problem. There is nothing but defeat for those who want a balanced pleasant-to-live-in, and also efficient land, when the low density estates sprawl endlessly. With the tower blocks and the space around them, there is the chance of a fine, harmonious result.

Mr. Brooke's decisions are an important challenge to the architect and the civil engineer. As Sir Hugh Casson said a week or so ago, announcing his appointment as consultant architect to Brighton, "I think you've got to face the fact that you've got to build high these days. When and where is the problem."

Coal Pipeline to the Blue Danube

From Germany there come new reports of a coal pipeline. This will be similar to those already in operation in the United States and Russia and will carry hard coal by hydraulic means from the Ruhr coalfield to industrial centres.

The object of the exercise is to fight competition from oil coming into Bavaria from Russia and the Mediterranean ports. The undertaking will be financed by a group consisting of the Ruhr Coal Advisory Company, the Hard Coal Mining Associations, and the Society for Hydraulic Transportation. The finance group has obtained the help of the Consolidated Coal Company of Pittsburg on the side.

This company has been operating a coal pipeline 110 miles long in Ohio since 1957. The projected pipeline will run from the eastern part of the Ruhr basin via Soest, Wildungen, Fulda, Kissingen and Erlangen to Regensburg. The pipeline will bring cheap coal to Bavarian industry.

In addition there will be a number of off-loading points from which river barges will take over and carry coal on to Austrian centres on the Danube. It is expected that the pipeline will have a diameter of 400 millimetres and be able to handle some 3 million tons of hard coal a year.

Education by Consultancy

Steadily the specialists of Europe are uniting; and long before the political leaders succeed in bringing the seven states of the European Free Trade Area alongside the six of the European Common Market.

Not so long ago it was the European electrical appliance manufacturers. Now it is the management consultants. Meeting in Vienna they have formed the Federation of European Management Consultants. Its (inevitable) code-word is FEACO (Fédération Européenne des Associations de Conseils en Organisation). The members are France, Sweden, West Germany, Holland, Switzerland and Great Britain.

The management consultants have a double effect. Serving more than 6,000 industrial and other organisations, mostly in this country but a useful number of them overseas, they are constantly active in raising standards, in imparting new ideas, in putting new zest not only into the productive activities of companies but into the thinking of their executives.

Their second effect is longer in making itself fully felt. Travelling the world the consultant engineer, solving one problem and passing on to the next, is in a continuous process of education. As the years and the assignments pile up so do his experience and skill. The benefit for those who use consultant services, and indirectly throughout the engineering industries, is obvious.

and a Future for 50 Million People

The road to a better life for 50 million people in the region of the river Indus, on the western side of the Indian continent, is opened up by the signing of the Indus Waters Treaty in Karachi.

Ten years of bickering, and of quiet and painstaking work by officers of the World Bank, have ended in mutual congratulations between heads of State and in a substantial financial agreement between nations of the Commonwealth, the United States, and West Germany. The United Kingdom, Canada, Australia and New Zealand are all to help meet the cost of bringing water to this vast area of arid poverty.

Several hundred miles of 300 ft wide canals are to be constructed linking the Indus, Jhelum, Chenab, Ravi, Beas and Sutlej rivers. Barrages and dams, communication works and a mass of supporting installations have all to be designed and built. The extent of the engineering work called for is overtopped only by the relief of sub-standard existence that will flow from the project's success.

On the basis of irrigation, of water conservation and power production, a significant part of the people of a whole continent will begin to rise towards a life in which they have sufficiency of food, relief from the heaviest forms of drudgery, time to think of other things than how to subsist, and opportunity to join in trade with others whose good fortune came with rather less delay.

Whitby Exploits Natural Gas Boreholes

Whitby is the first town in Great Britain to be wholly supplied with indigenous natural gas. Part of the old gasworks is used in reforming the natural gas so that it acts and smells like town's gas.

NATURAL gas was originally found by the BP Exploration Company in 1938 during the course of its search for oil in the United Kingdom. This discovery has been further explored with ICI since the end of the Second World War with a view to its possible use by the latter firm at their Tees-side chemical plant. ICI found, however, that the reserves of gas were insufficient for their requirements and in September, 1959, the North Eastern Gas Board, in agreement with British Petroleum and ICI, arranged to purchase the gas and initially supply Whitby, a town of approximately 12,000 inhabitants. In the course of operations eleven wells have so far been drilled, but only two, the second and tenth, have been proved to be gas producers, the others being dry. The two wells are independent of each other and do not draw from a common reserve.

The number 2 well has a closed pressure of 1,700 lb per sq. in and draws from an upper limestone layer about 4,200 ft below surface level. It is capable of producing gas at the rate of 2·5 million cu. ft per day. The other well has a closed pressure of 1,900 lb per sq. in and draws gas from a lower limestone strata about 4,800 ft below ground level. It is capable of providing a flow rate of up to 2 million cu. ft per day. The producible gas reserves from the two wells have been estimated to be 1,500 million cu. ft. It is thought that this estimated quantity may possibly be exceeded by a further 2,500 million cu. ft, and practical steps are being taken over the next year or so to determine accurately the extent of the full reserve.

The two wells were mud-sealed and capped until April this year, when they were reopened and fitted with new casing heads and " Christmas tree " control valves.

Methane forms 93 per cent of the natural gas from both wells. The average calorific value is approximately 1,000 Btu per cu. ft and specific gravity 0·59.

After dewatering and pressure reduction at the wellhead, gas flows by a 3 in steel main directly to the Whitby gasworks where, after pressure and flow control, it passes through oxide purifiers for the removal of any hydrogen sulphide into a methane holder, from which gas is taken at low pressure directly to a PG Hercules plant for reforming methane to hydrogen and carbon monoxide of calorific value 290 Btu per cu. ft. This is followed by cold enrichment with methane to a gas of 500 Btu per cu. ft, specific gravity 0·54.

This gas wholly replaces the town's gas, now made from carbonising coal in horizontal retorts with producer gas dilution. To cover for any temporary interruptions of flow of natural gas from the wells, provision is made for reforming of butane from a 90 ton tank to gas of the same approximate composition.

The whole plant was put into commission a few weeks ago.

Most interesting feature is the wellhead equipment which is the first of its kind in the UK. It is shown in the diagram below.

The valve arrangement on the well enables gas to be taken either from the centre tube or from the annulus and it flows directly to a separator for knocking out any free water, although it is anticipated that free water will be absent at the flow rates being operated. The separator is 12 in in diameter and 5 ft long, suitable for a working pressure of 2,000 lb per sq. in. The separator is fitted with a liquid level controller and a diaphragm-operated water discharge valve. A relief valve is also fitted, with a direct connection to a vent stack with a flame-trap head.

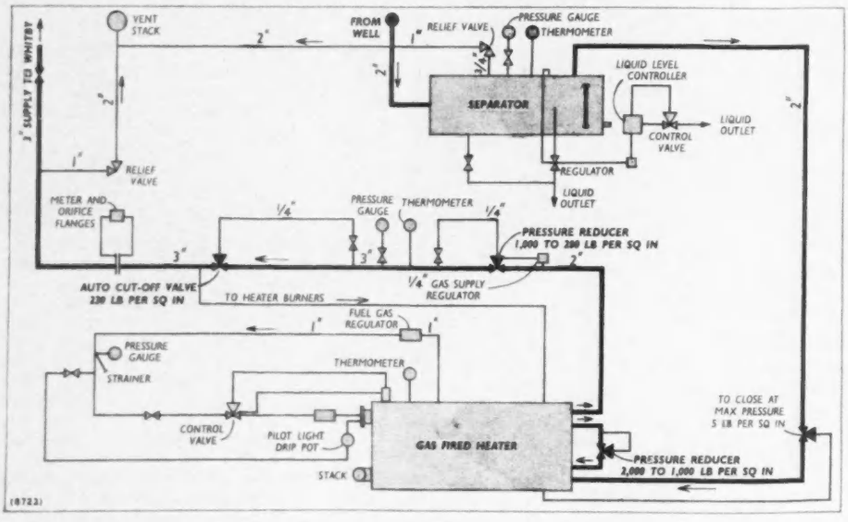
From the separator the gas passes through a horizontal gas-fired heater, 24 in diameter and 10 ft long, required to overcome freezing conditions which could arise from adiabatic expansion of the gas and the Joule-Thompson effect. Prevention of ice and methane-hydrate formation is necessary to ensure continuous operation of the pressure reducing equipment. The fire tube of the heater is fired by natural gas and the burners are thermostatically controlled.

The gas passing through the first tube bundle is heated to 150° F. It is then cooled to approximately 70° F on being expanded from 1,900 to 1,000 lb per sq. in. After passing through the second tube bundle the gas is reheated to 150° F and subsequently cooled to 70° F, after expanding from 1,000 to 200 lb per sq. in.

High pressure is the main feature of the transmission line to the Whitby Works; there is approximately six miles of 3 in steel main, which is capable of carrying the full anticipated requirements, with an initial pressure of 200 and a final pressure of 90 lb per sq. in.

The pipe used was 3 in outside diameter by 5 wg thick hot-finished seamless steel tubing, manufactured from API 25 L, grade B material with ends sized and bevelled to API Standard 5L (17th edition). The tubing was painted internally with red lead paint, coated externally with bituminous solution primer and further protected externally with woven glass reinforced bitumen sheathing, factory applied.

Main function of the wellhead equipment is to reduce the pressure from 2,000 to 200 lb per sq. in without any freezing up or uncontrolled water condensation.



Put Natural Gas (Methane) at Whitby into Perspective ....

	Amount of gas in millions of cu. ft per day
Potential natural gas from 2 boreholes for Whitby	4·5[a]
Natural gas imported as liquid from USA since February 1959 (converted to a daily figure over 18 months)	1·2[b]
Pure methane drained from coal mines (a small percentage of which is utilised)	15·5[c]
Total gas produced in UK in 1959/60 (divide by 2 to compare with natural gas which has roughly twice the calorific value of town's gas)	1,440[d]

a See text
b 12,000 tons over 18 months
c Gas Council, May 1959
d Gas Council, Sept. 1960

Much histrionic comment has been made on the possible redundancy effects of replacing traditional town's gasworks by imports of natural gas. So those responsible for natural gas have avoided publicity on their movements. But there is little justification for sentimentality in retaining old processes when improving technology quite clearly states that improvement can be made in the long term.

New gas-making processes will not change the picture overnight. High pressure gasification of coal, gasification of oil and importation of liquid methane have been thought feasible for a decade, but none has yet revolutionised the industry to anyone's harm.

So with natural gas at Whitby. But feelings here could be especially confused. Here is a source of high grade gas which is an indigenous supply (like coal), but which makes an old gasworks virtually redundant. What is more, in this instance, private enterprise has teamed up with a nationalised utility to apparently everyone's good. If there is one logical attitude towards these developments which permits of further advances in the future it is to wholeheartedly applaud the moves at Whitby; and to go even further and work for political stability, with the possibility of a natural gas pipeline from France's Lacq oil and gas fields, and large imports of liquefied methane from America or the Middle East.

Ductile Chromium via Electrolysis

Another positive step forward towards making massive chromium which is ductile at room temperature has been made by the US Bureau of Mines at Washington (report number 5589). The process used was electrolysis of chromium trioxide solution at high temperatures. The metal thus obtained could be hot-worked to rod and sheet and drawn to wire which was ductile at room temperature. Note that although the ingot analysis shows that hydrogen and oxygen are high in the ingot, it seems to be the final nitrogen content which correlates with the elongation.

Tensile Properties of Chromium Wires at 25°C

Ingot analysis, ppm*			Wire analysis, ppm†	Ultimate tensile strength, 10^6 lb per sq. in	Elongation on 1 in, per cent
O	H	N	N		
245	6·7	50	40	69	10
245	6·7	50	40	69	16
245	6·7	50	50	68	15
245	6·7	50	50	68	16
245	6·7	50	30	57	26
40	2·0	30	210	72	0
40	2·0	30	210	70	0
40	2·0	30	220	77	0
	2·0	30	220	74	0

* = vacuum fusion method
† = Kjeldahl method

Plastic-Coated Galvanised Steel Pipe

A belt-and-braces attitude towards stopping corrosion of electrical conduit is talking both safety and sense. In the illustration below one can see the unsafe condition of such tubing which occurred in an American steel corporation's coking plant. Republic Steel's solution was to put a plastic covering on top of galvanised steel pipe.

Plastic Coatings comment that they have made many lengths of pipe with belt-and-braces protection of pvc and zinc (they just applied the pvc) and that it has all been destined for electrical conduit. So far they have made conduit in

diameters up to 3 in but this is more limited by the definition of "conduit" than by the process, which can handle any size of tubing. To avoid embrittlement and to allow the conduit to be bent, the grade of pvc is one which contains a non-migrating plasticiser; there is also an addition of carbon black for good weathering and chemical resistance. Coating thicknesses when applied by the plastisol process can be up to 1 mm, but alternative processes are extrusion for mass production, with no limitations on thickness, or fluidised bed coating which gives thin coatings especially successful with non-plasticised pvc compounds and nylon.

Back to Republic Steel's troubles. Five thousand feet of plastic-coated electrical tubing varying in size from ¾ to 1½ in was installed 18 months ago in their coke oven areas. Recent inspection showed that it was in just about the same condition as when it was originally installed; plant engineers expect it to last for "many years to come."

One particular trouble spot was in its coke conveyor gallery where a strong concentration of ammonia-still waste fumes had, over the years, badly corroded the standard galvanised conduit which housed lighting lines and lines for control of conveyor motors. This caused grounding and shorting circuits, resulting in loss of lighting facilities and down-time for the coke conveyor.

In still another area, a different type of corrosion problem exists in the company's ammonium sulphate dryer building where the coal by-product is processed. Heavy wall galvanised conduit has been decimated in a short time as a result of the corrosive dust in the atmosphere.

Fitting and coupling is quite simple; just strip back the plastic covering, make the joint, and cover it with double thickness of a corrosion resisting polyethylene or pvc tape.

Republic Steel Corp., New York 17, NY, USA.
Plastic Coatings Limited, Guildford, Surrey.

Galvanised Rails in Dutch Coal Mines

By a rather roundabout route comes news from Holland. American Zinc Institute, in urging its members to do likewise, reports that by hot dip galvanising rails which are used to carry heavy ore loads, a number of Dutch coal mine operators are now getting three times the service life previously experienced with uncoated steel rails.

Information from the Stichting Doelmatig Versinken (the Dutch galvanising trade association) shows that conventional steel rails formerly used in the Dutch mines became corroded and unsafe after two to three years as a result of the constant exposure to water, humidity, and aggressive chemical attack; in coal mines water is frequently high in sulphur content. Since applying a protective zinc coating by hot dip galvanising, this "enterprising" group of miners have discovered that the rails can now be relied on for from five to six years of efficient and safe heavy-duty service.

Extremely aggressive conditions in the mines, at depths of generally 2,000 to 2,200 ft, attack rails heavily, and every year of gain is of significant profit in maintenance costs. Since most of the mines contain water at elevated temperatures and have sulphate and sulphide content, unprotected steel rails corrode at an accelerated rate.

Dutch hot dip galvanised rails are coated with from 3·2 mils (0·0032 in) to 4·0 mils of zinc, or approximately equivalent to 2 to 1¼ oz per sq. ft. While the zinc is eroded away by friction on the bearing surface of the rails, this is of no importance since the same friction removes any trace of rust that tends to develop here. The areas which get important protection are the sides and base of the rails.

"Dounreay" Painted with Chlorinated Rubber

To be more specific it is "the sphere" which has been covered with a five-coat chlorinated rubber paint system. This sphere is situated west of John O'Groats, within a hundred yards of the sea. Tretol were responsible for the system.

Under control of the UKAEA virtually every known type of anticorrosive composition—including fairly recently developed materials such as epoxies, neoprenes, vinyls, in addition to the more traditional types of paint such as bituminous, alkyds, and chlorinated rubbers—were all applied to the external surface facing the sea and observations maintained over a long period.

Originally "the sphere" was protected with metallic zinc spray to a thickness of approximately 0·004 in but the constant build-up by precipitated salts made it apparent that additional protection was very necessary if the high initial cost of the metallic zinc coating was not to be frittered away within a short space of time.

This chlorinated rubber paint system has resisted the rigorous conditions so well that it has now been selected for use on similar structures at this establishment.

Tretol Limited, The Hyde, London, NW9.

Gold-Coated Glass—Bad Weather Vision

There are two systems of putting gold on to glass in order to produce a de-icing system which can be seen through. Note, especially though, that they are emerging from the aircraft no-expense-spared bracket into the everyday world of engineering. The illustration shows Triplex gold-film glass being fitted to the driving cab of a Brush 1365 diesel-electric locomotive in the Brush Electrical Company's works at Loughborough.

Triplex' product is made by vacuum sputtering, in which gold vapour is made to distribute itself on the glass under influence of an electric field. Film thicknesses are about two ten-millionths of an inch, giving a specific resistance of about 10 ohms per square with a heat input of up to 600 watts per sq. ft.

Napier's system is one of vacuum evaporation, where the movement is normal vapour diffusion towards a cold body placed near a hot source of metal vapour. Sierracote, as it is called, gives specific resistances of between 6 and 90 ohms per square. This permits quite irregularly shaped areas to be heated uniformly and provides a wide choice of operating voltages. This coating can be applied to glass or plastic with

equal success and the latter can be formed after the coating is applied.

In recent weeks Triplex have also modified their "standard 10 ohms per square" coating to perform like Sierracoate. Now the resistance may be graded over a surface with irregular outline to give uniform heating.

Triplex Safety Glass Company Limited, Hythe Road, Willesden, London, NW10.
D. Napier and Son Limited, The Vale, W3.

Plain Words

By Capricorn

A ONE-SENTENCE paragraph in *The Times* brings strange news from the Orient: "Saigon newspapers announce that they are to suspend their horoscope columns to help stamp out superstition among the Vietnamese public."

Such a drastic cut in the innocent amusements of the Vietnamese is disturbing to a Western mind, but I suppose it is necessary in the relentless interests of applied industrialisation. In societies like our own, which have developed organically from within, things have just been allowed to happen naturally and no one has seriously thought of moulding our future by artificial pruning of our culture.

But in Vietnam, clearly, it must be different. There is an urgent need to explain the simple mechanics of everyday engineering to the credulous public. They must be allowed to understand, for example, that extrovert machine the steam locomotive (perhaps in Vietnam they have omitted that primitive stage of transport and gone straight into dieselisation); the internal-combustion box of tricks beneath the car bonnet; the tower crane which manages to stand up when it looks as though it ought to fall down; the aircraft that are obviously so much more marvellous than birds; the telephone so easily taken for granted. All these things and many more must be reduced to Q.E.D. form. Since there is so much to be explained in rational terms, everything that cannot be explained in similar terms must be swept aside. Otherwise the Vietnamese would be like the exasperating, intelligent child who pursues his questioning until he stumps his father for an answer. Questions that cannot be answered must not be asked. There is no time to waste in the march of progress.

It would be churlish of us to begrudge the Vietnamese their imported industrialisation. We can hardly take the credit for inventions and developments which were originated by our grandfathers. And although we have made our contribution to the progress of engineering, theoretical knowledge and practical experience inevitably become international property. Good luck to them in getting away to a flying start. May they go far (but not too far).

Meanwhile I hope a few of them spend some of their time on a visit to England, perhaps as engineering students. They will find that all our popular newspapers carry horoscope columns, and that superstition is still only just below the surface of the most sophisticated Englishman. They might learn, too, something that we have learnt the hard way—that there is an unlimited number of false peaks on the mountain of knowledge. That as fast as we find the answer to one question, it raises an entirely new question.

And they may find, also, that though we have discovered many new things, we have forgotten some of the old truths which—if I am not already too late—they still retain.

Letters to the Editor

Mixing Gases

SIR, It is difficult to appreciate why Dr. P. Chambadal should at this time address the British engineer on the subject of "Mixing Gases and Gibbs' Paradox" if it is only to discourage him from using the concept of permeable membranes (ENGNG., 16 Sept. '60, p. 398).

Dr. Chambadal discards the membrane and equates the diffusion of a gas to throttling. He has exchanged the concept of a reversible expansion behind a permeable piston for an irreversible process, for which he is able to quote the entropy change. Bearing in mind that entropy changes can be evaluated only along reversible paths it would be interesting to know what advantage the throttling process possesses. Further, in the section entitled "Interpretation" is "1 lb of perfect gas under pressure p and temperature T" to be considered at rest (non-flow process) or in motion (flow process)?

When Dr. Chambadal has clarified the above point further examination of this article may be profitable.

Yours faithfully,
E. A. BRUGES.

University of Glasgow,
Spencer Street,
Glasgow, W3.
23 September, 1960.

Concrete Strengths

SIR, In my previous letter (ENGNG., 19 Aug. '60, p. 236) I referred to the possibility of steps, lasting for a day or more, being present in the strength development pattern of normally-cured concrete, and some recent results given in the accompanying graph indicate such a step fairly clearly.

A batch of 1 : 5·6 concrete using OP cement, and with a total water/cement ratio of 0·55, was made into over fifty 4 in cubes and cured at 62° F. The first intention was to investigate the pattern of strength development around the 28 day period, but a few strengths obtained at 5, 6 and 7 days suggested a rapid rise in strength between 6 and 7 days. Thereafter, tests at 6 hour intervals indicated an almost constant strength for one and a half days, followed by another rapid increase, and it was surmised that a step was present which could be represented by the broken line shown in the illustration.

A second, and as nearly as possible identical, batch of cubes was then made to investigate in detail the presumed rapid rise between 6 and 7 days, but it became clear on the fifth day that strengths were coming well above the expected values. It was interesting to note, however, that the strength at 7 days was the same as for the first batch. The mix was repeated again, when the strength rose rapidly during the sixth day (line A-B), this time following closely the path suggested by the first mix.

Previous tests with this mix had shown that the average rate of strength development at 6½ days, based on a smooth curve drawn through 3 to 28 day results, was about 170 lb per sq. in per day. The slope of the line A-B is about 400 lb per sq. in per day, that is, over twice the average.

Several practical implications of this stepping effect, if indeed it is confirmed by further tests, are clear. For example, batches of cubes from mixes giving the same average strength curve, can vary by as much as 300 lb per sq. in when tested at the same age, and this may perhaps explain the intractable margin of error which Professor J. W. H. King and others have found when attempting to forecast normal strengths by accelerated methods. It will also be seen that even when the average rate of strength increase over 28 days is known, the error in forecasting 7 day from 6 day strengths could be as much as 350 lb per sq. in.

Yours faithfully,
M. S. THOMPSON.

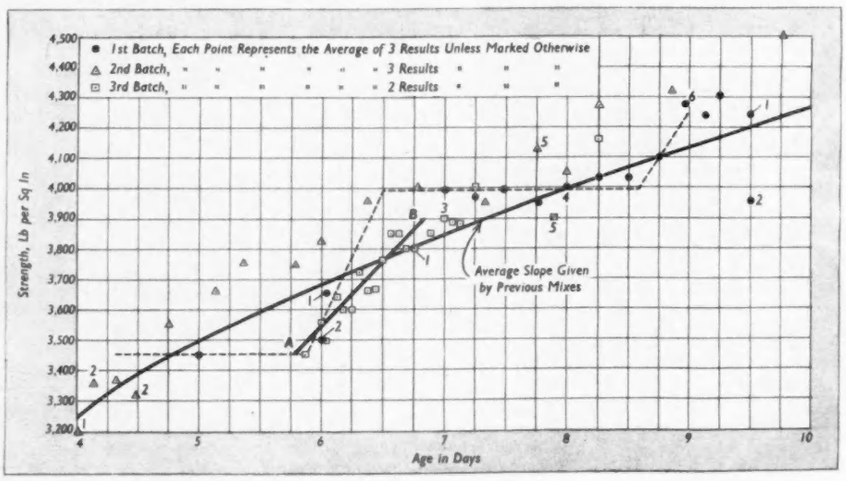
11 Old Fold View,
Barnet, Hertfordshire.
21 September, 1960.

Mechanical Properties

SIR, Dr. A. C. Vivian's letter (ENGNG., 23 Sept. '60, p. 404) demonstrates how slow we are to accept new ideas when such are concerned only with a better understanding of the properties of matter.

He complains that nothing has happened since he planted the seed of his new idea—vols. 156 and 157 of your journal show how good the idea is. But, as keen gardeners know, after a seed has been planted it needs care and attention. The resulting plant has then to be propagated and encouraged to spread. If the seed dropped on stony ground then germination would be unlikely and, for some, 1943 and 1944 were "stony ground." But, in any case, it usually takes about 20 years for a new idea to bear fruit!

Take, for example, a subject in which I am interested, namely, the strength of concrete. In 1928, in the United States, Richart, Brandtzaeg and Brown published the results of triaxial compression tests on concrete specimens. The next tests were in 1941 by F. C. Smith and, in 1949, by Bulmer, Jones and McHenry; and there the matter rested, so far as I know, until I recently published some preliminary results in your journal. On this basis, Dr. Vivian can expect


● 1st Batch, Each Point Represents the Average of 3 Results Unless Marked Otherwise
△ 2nd Batch, " " " " " " 3 Results " " "
⊡ 3rd Batch, " " " " " " 2 Results " " "
Strength, Lb per Sq In
Age in Days
Average Slope Given by Previous Mixes
A
B

further development 20 years after his first paper, in 1963 and possibly again in 1975.

It would seem that the time is ripe for a further paper by Dr. Vivian.

Yours faithfully,

T. N. W. AKROYD.

Constructional Services Limited,
123 Victoria Street,
London, SW1.
22 September, 1960.

Missile and Rocket Engines

SIR, One or two errors have crept into my recent article "British Missile and Rocket Engines" (ENGNG., 2 Sept. '60, p. 322).

The total impulse of the de Havilland Super Sprite engine is 120,000 lb per sec, and the hydrogen peroxide concentration should be given as 82 to 86 per cent. The average thrust of Imperial Chemical Industry's Wolfhound is 3,200 lb.

In the table at the bottom of page 323, the headings "Rolls-Royce Limited" and "Rocket Propulsion Establishment" should be separate, and there should be a heavy rule between the second and third columns. Rolls-Royce produce the engine for Blue Streak; while the Rocket Propulsion Establishment, Westcott, produce the Mayfly, Raven and Cuckoo engines.

Incidentally, RPE (an establishment of the Ministry of Aviation) were responsible for the initial design of the Gamma and Scorpion engines.

Yours sincerely,

G. V. E. THOMPSON.

1 Herbert Road,
Hornchurch,
Essex.
22 September, 1960.

Events in Advance

Air Conditioning and Refrigeration Up-to-date

IN VIEW of the success which attended the First Industrial and Commercial Refrigeration Exhibition, held last February, a larger venue has had to be arranged for its successor, which will be known as the Second Refrigeration and Air Conditioning Exhibition. This event will be held, therefore, at Earl's Court, London, SW5, from 11 to 14 April, 1961.

The scope of next year's event will also be considerably widened, so as to cover not only industrial refrigeration and air-conditioning machinery, equipment, components and controls, but also domestic models and applications. Appliances and materials useful for insulation purposes will also be included in the objects of the exhibition.

In addition to the exhibition, there will be a Refrigeration Convention which will comprise a commercial as well as a technical section, and support for this event is confidently expected from a number of international refrigeration bodies. It is hoped to make films a special feature of the convention.

Both the exhibition and the convention are being sponsored by *World Refrigeration*, and all inquiries should be made to Mr. Patrick Smyth, 1 Crane Court, Fleet Street, London, EC4 (Telephone FLEet Street 0197). This year's exhibition, at the old hall of the Royal Horticultural Society, was attended by some 8,000 persons, many of them from overseas.

Exhibitions and Conferences

Steels for Nuclear Reactor Power Circuits, Symposium.—Wed., 30 Nov., to Fri., 2 Dec., in the Hoare Memorial Hall, Church House, Great Smith Street, London, SW1. Will be included in the activities of the British Nuclear Energy Conference, of which the Iron and Steel Institute is a member. Organised by the Iron and Steel Institute, 4 Grosvenor Gardens, London, SW1. Tel. SLOane 0061.

Hot Laboratory and Equipment Conference, Eighth.—Sun., 11 Dec., to Wed., 14 Dec., in San Francisco, California, USA. Will be held simultaneously with the winter meeting of the American Nuclear Society and in conjunction with the nuclear industry exhibit and meeting of the Atomic Industrial Forum. Apply to the secretary, American Nuclear Society, 86 East Randolph Street, Chicago 1, Illinois, USA.

Statistical Mechanics (with Special Reference to Irreversibility), Conference on.—Mon. and Tues., 19 and 20 Dec., at Queen Mary College, Mile End Road, London, E1. Organised by the Institute of Physics and the Physical Society, 47 Belgrave Square, London, SW1. Tel. BELgravia 6111.

Canadian Restaurant Association's Annual Convention and Exhibition, 17th.—Mon., 20 Mar., to Thurs., 23 Mar., 1961, at the Automotive Building, Exhibition Park, Toronto. Apply to Mr. D. G. Adamson, director of conventions, Canadian Restaurant Association, 60 Avenue Road, Toronto 5, Ontario, Canada.

Meetings and Papers

British Institution of Radio Engineers

EDINBURGH
"Technical Education for the Radio and Television Industry," by J. B. Rimmer. Scottish Section. Department of Natural Philosophy, The University, Drummond Street, Edinburgh. Wed., 5 Oct., 7 p.m.

GLASGOW
"Technical Education for the Radio and Television Industry," by J. B. Rimmer. Scottish Section. Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. Thurs., 6 Oct., 7 p.m.

British Interplanetary Society

DERBY
"Aims of Space Research," by L. J. Carter. Midlands Branch. Seven Stars Inn, 97 King Street, Derby. Tues., 4 Oct., 7.30 p.m.

Building Centre

LONDON
Film: "Right at the Top," exhibited by Redland Tiles Ltd. Wed., 5 Oct., 12.45 p.m.

Institute of Information Scientists

LONDON
"New Research on Chemical Abstracts," by Dr. G. Malcolm Dyson. Swedenborg Hall, Barter Street, Bloomsbury Way, WC1. Wed., 5 Oct., 6.15 p.m.*

Institute of Marine Engineers

KINGSTON-UPON-HULL
"Heatless Repairs to Fractured or Broken Castings," by N. Tinwell. Kingston-upon-Hull and Humber Area Section. Royal Station Hotel, Kingston-upon-Hull. Thurs., 6 Oct., 7.30 p.m.

LIVERPOOL
"Marine Insulation," by G. Laing. Merseyside and North Western Section. Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Mon., 3 Oct., 6 p.m.

Institute of Petroleum

LONDON
"Synthetic Lubricants for Gas Turbines," by J. S. Elliott and E. D. Edwards. Wed., 5 Oct., 5.30 p.m.*

Institution of Civil Engineers

LONDON
"Utilisation and Conservation of Water in the Chemical Industry," by J. A. Cooper and L. Gilling Smith. Tues., 4 Oct., 5.30 p.m.*

Institution of Electrical Engineers

BIRMINGHAM
Chairman's Inaugural Address, by Brigadier F. Jones and Annual General Meeting, at 6 p.m. Conversazione, at 7.30 p.m. South Midland Centre. Grand Hotel, Birmingham. Mon., 3 Oct.

Institution of Engineering Designers

LONDON
"Design and Manufacture of Mechanical Instruments for Pressure, Temperature and Liquid Level," by E. A. Nicholls. Thurs., 6 Oct., 7 p.m.

Institution of Engineers and Shipbuilders in Scotland

GLASGOW
Presidential Address, by J. Brown. Tues., 4 Oct., 6.30 p.m.

Institution of Heating and Ventilating Engineers

LONDON
"Recent Developments in the Application of Refrigeration to Air Conditioning," by N. F. Bradshaw. Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, SW1. Thurs., 6 Oct., 6 p.m.*

NOTTINGHAM
"Design and Application of Package Boilers and Automatic Stokers," by R. D. Northcote. East Midlands Branch. College of Arts and Crafts, Waverley Street, Nottingham. Wed., 5 Oct., 6.30 p.m.

Institution of Highway Engineers

LONDON
"Lessons Learned on the Design, Construction and Maintenance of Motorways, from the County Surveyor's Angle," by H. Bowdler. Institution of Structural Engineers, 11 Upper Belgrave Street, SW1. Fri., 7 Oct., 5.30 p.m.*

Institution of Mechanical Engineers

NEWCASTLE UPON TYNE
"Pipe Ranges for Water at High Pressures and High Temperatures, with Special Reference to Boiler Feed Systems," by K. B. Jacob. North Eastern Branch. Neville Hall, Westgate Road, Newcastle upon Tyne. Mon., 3 Oct., 6 p.m.

NOTTINGHAM
"Automobile Lubrication and Lubricants," by A. Towle. Crompton-Lanchester Lecture. East Midlands Branch. Engineering Building, The University, Nottingham. Thurs., 6 Oct., 7.15 p.m.

WEYMOUTH
"The Computer as an Aid in Engineering Design," by E. B. Fossey. Southern Branch. South Dorset Technical College, Weymouth. Thurs., 6 Oct., 7.30 p.m.

Institution of Plant Engineers

EDINBURGH
"Good Communications," by A. W. Millar. Edinburgh Branch. 25 Charlotte Square, Edinburgh. Wed., 5 Oct., 7 p.m.

LEICESTER
"Metal Stitching," by N. Tinwell. Leicester Branch. Saracen's Head Hotel, Leicester. Wed., 5 Oct., 7.30 p.m.

Institution of Production Engineers

DUNDEE
"The Numerical Analogue Control of Machine Tools", by O. S. Puckle. Dundee Section. Royal Hotel, Union Street, Dundee. Wed., 5 Oct., 7.30 p.m.

OXFORD
"Recent Technological Advances in India," by F. W. Cooper. Oxford Section. Town Hall, Oxford. Tues., 4 Oct., 7.30 p.m.

Institution of Structural Engineers

LONDON
Presidential Address, by Lieut.-Colonel G. W. Kirkland. Thurs., 6 Oct., 6 p.m.*

Junior Institution of Engineers

LONDON
"Amateur Radio: An Explanation of the Activities of a 'Ham,'" by J. J. A. Tennant. Fri., 7 Oct., 7 p.m.*

London Association of Engineers

LONDON
Film Evening, including "The M1." Junior Army and Navy Club, Whitehall Court, SW1. Sat., 1 Oct., 6.30 p.m.

Newcomen Society

LONDON
"Some Railway Facts and Fallacies;" Presidential Address, by Charles E. Lee. Annual General Meeting. Wed., 5 Oct., 5.30 p.m.

Reinforced Concrete Association

LIVERPOOL
"Reinforced Concrete as a Material for Nuclear Reactor Containment," by T. C. Waters. North Western Branch: Liverpool Engineering Society, 9 The Temple, 24 Dale Street, Liverpool. Tues., 4 Oct., 6.30 p.m.

Royal Institution of Naval Architects

LONDON
"Performance Data of Propellers for High-Speed Craft," by R. N. Newton and H. P. Rader. Thurs., 6 Oct., 5.15 p.m.

Society of Chemical Industry

GLASGOW
"Fusion Electrolysis of Titanium," by Dr. W. J. Kroll. Royal College of Science and Technology, Glasgow, C1. Fri., 7 Oct., 6 p.m.

Society of Engineers

LONDON
"Some Notes on Hovercraft," by W. A. Crago (with film). Geological Society, Burlington House, Piccadilly, W1. Mon., 3 Oct., 5.30 p.m.*

Society of Instrument Technology

CHELTENHAM
"Hydraulic Servo Systems," by Professor E. B. Pearson. Cheltenham Section. Belle Vue Hotel, Cheltenham. Mon., 3 Oct., 7.30 p.m.

FAWLEY
"Basic Principles of Digital Instrumentation," by D. S. Evans. Fawley Section. Administration Building, Esso Refinery, Fawley. Fri., 7 Oct., 5.30 p.m.

The address and telephone number of the headquarters of each institution are given below. Meetings in the headquarters town are held there unless otherwise stated. An asterisk (*) is placed where it is understood that refreshments are available prior to the time stated.

British Institution of Radio Engineers, 9 Bedford Square, London, WC1. (MUSeum 1901)
British Interplanetary Society, 12 Bessborough Gardens, London, SW1. (TATe Gallery 9371)
Building Centre, 26 Store Street, London, WC1. (MUSeum 5400)
Institute of Information Scientists. Apply to Mr. J. Farradane, Torran, Croft Road, Orpington, Kent.
Institute of Marine Engineers, Memorial Building, 76 Mark Lane, London, EC3. (ROYal 8493)
Institute of Petroleum, 61 New Cavendish Street, London, W1. (LANgham 3583)
Institution of Civil Engineers, Great George Street, London, SW1. (WHItehall 4577)
Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, WC2. (COVent Garden 1871)
Institution of Engineering Designers, 38 Portland Place, London, W1. (LANgham 8847)
Institution of Engineers and Shipbuilders in Scotland, 39 Elmbank Crescent, Glasgow, C2. (Central 5181)
Institution of Heating and Ventilating Engineers, 49 Cadogan Square, London, SW1. (SLOane 3158)
Institution of Highway Engineers, 47 Victoria Street, London, SW1. (ABBey 3891)
Institution of Mechanical Engineers, 1 Birdcage Walk, St. James's Park, London, SW1. (WHItehall 7476)
Institution of Plant Engineers, 2 Grosvenor Gardens, London, SW1. (SLOane 0469)
Institution of Production Engineers, 10 Chesterfield Street, London, W1. (GROsvenor 5254)
Institution of Structural Engineers, 11 Upper Belgrave Street, London, SW1. (SLOane 7128)
Junior Institution of Engineers, Pepys House, 14 Rochester Row, London, SW1. (VICtoria 0786)
London Association of Engineers, Elder Cottage, Hurst, Reading, Berks. (Hurst 5083)
Newcomen Society, Science Museum, Exhibition Road, London, SW7. (KENsington 1793)
Reinforced Concrete Association, 94-98 Petty France, London, SW1. (ABBey 4504)
Royal Institution of Naval Architects, 10 Upper Belgrave Street, London, SW1. (SLOane 4622)
Society of Chemical Industry, 14 Belgrave Square, London, SW1. (BELgravia 3681)
Society of Engineers, Abbey House, Victoria Street, London, SW1. (ABBey 7244)
Society of Instrument Technology, 20 Queen Anne Street, London, W1. (LANgham 4251)

Czechoslovakia, a Bridgehead for Trade?

Because Czechoslovakia has traditional ties with Western engineering and is technically advanced, she offers a promising potential market for United Kingdom products.

By E. P. Ward, M.A., A.M.I.Mech.E.

SOME weeks ago I was approached by a young sales engineer who wished to extend his company's marketing activities to the Communist countries, but did not know how to set about it. As I had been in Russia and East Germany and was about to visit Czechoslovakia, I said I would do my best to help. This article is my attempt to answer his inquiry.

As I took off from London Airport in the Tu 104 jet aircraft bound for Prague and saw the ground sink away beneath the drooping swept-back wings, I started to think about my task. It occurred to me that technically Czechoslovakia was perhaps the most advanced of all the Communist republics. She also had traditional industrial connections with the West, particularly with France and Britain. Surely there could be no better starting point for an exporter who wished to secure a foothold within the Soviet bloc. He might in fact be well advised to make his initial reconnaissance at the Brno Fair, which I was to visit during my stay.

I recalled that the President of the Board of Trade, Mr. Reginald Maudling, had said when opening the 1960 machine tool exhibition at Olympia: "Trade between highly industrialised countries has been growing much faster than trade between industrial countries and primary producers . . . I think that it's becoming true that the best place to sell a machine tool is where they make machine tools." Technical accomplishment means greater scope for trade. Czechoslovakia is interested in a wider range of purchases than other Communist countries and has a wider range of goods to sell.

There is certainly an affinity between Czechoslovakia and Western countries, as I discovered on reaching Prague. Prague reminded me of Basle or Zürich, with the added graces of the Vltava and the Hradčany, river and castle for which the city is famous. Shops were contemporary in style and displayed modern fashions and consumer products in their windows. People were well dressed, looked well fed and were cheerful and relaxed. I bought a gramophone record, a current hit called "Ven," as evidence of the pervading influence of rock and roll, only to discover from my brother on reaching home that it was also popular in England under the title "When."

I asked the very pleasant and intelligent young man who accompanied me as interpreter how he accounted for the extent to which Western ways had been assimilated. "Lenin," he replied, "said that we should take the best from every nation." It was a reasonable point of view.

But there are other reasons for believing that Czechoslovakia is about to become a significant market for United Kingdom trade. The Czechs themselves are clearly keen to welcome British products and to sell their own to Britain. I understand that the Czech section of the London Chamber of Commerce is to be expanded in view of growing opportunities for trade.

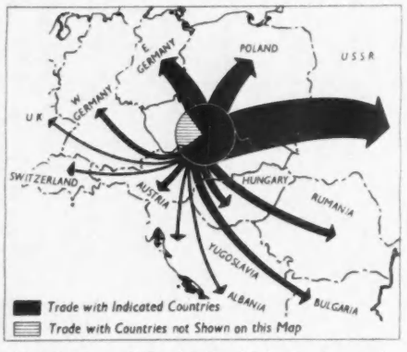
British exhibitors at the Brno Fair were confident. A representative of Solartron told me that they expected to sell every item on their stand, provided suitable arrangements could be made for payment. Since last year British representation has increased by 30 per cent.

One reason for Czech interest may be that owing to the concentration of resources on particular projects there are unwelcome gaps in her production pattern—gaps which cannot be filled by Communist countries technically less advanced. Czechoslovakia, therefore, depends to some extent upon the West. She is in fact the only Communist country which is a full member of GATT, the General Agreement on Tariffs and Trade, though Poland also attends the meetings as an observer.

At present West Germany provides a substantial fraction of Czech imports. But for historical and political reasons the Czech authorities appear to be unahppy about this arrangement, and would prefer to transfer part of this trade to Britain. They also seem to be casting an anxious eye on the European Common Market, partly because they believe it will be dominated by Germany, but partly, one suspects, for fear of trade discrimination.

Now would seem to be the time for the United Kingdom to renew her traditional interest in the Czech market, bearing in mind that since 1948 Czechoslovakia has been supplying the rest of the Soviet Bloc with engineering products. The striking rise in Czech capital exports and the relative decline in consumer exports is evidence of this activity. Thus the Czech market may also prove to be the gateway to a hinterland of other trading possibilities.

Why has trade with Czechoslovakia not flourished hitherto? Some 70 per cent of Czech foreign trade is with her partners in the Soviet bloc, as can be seen from the diagram below.



Distribution of Czechoslovakia's foreign trade.

Of the remaining 30 per cent, only 2 per cent is with Britain, as against 4 per cent with West Germany. Conversely, only 2 per cent of UK trade is with Iron Curtain countries and only 0·2 per cent with Czechoslovakia. In 1959, according to Board of Trade statistics, UK imports from Czechoslovakia amounted to £9,088,848; exports to Czechoslovakia were £6,156,235; and re-exports £1,917,162. There appears to be a small improvement in the 1960 figures. British imports from Poland are roughly three times as great. For comparison, UK trade with West Germany is valued at roughly £150 million in both directions. There would seem to be ample scope for an increase in Anglo-Czechslovak commerce.

Trade with Czechoslovakia has been complicated by certain financial questions. Agreements reached in 1949 regarding compensation for nationalised or expropriated British property and the settlement of inter-Governmental debts were honoured until 1954, when discussions were broken off. But though negotiations were later resumed, national and commercial debts have led to restrictions and the imposition of tight quotas.

Shortage of sterling in Communist countries generally has likewise hampered recent trade with Czechoslovakia, while security embargoes have also played a part. But there is reason to believe that a knife may soon be taken to this knot of problems.

In April this year a new three-year United Kingdom-Czechoslovak trade arrangement was signed in Prague. It provides for the creation of annual quotas for trade in each direction. The quotas, which are merely undertakings to issue licences, cover Czech purchases during 1960 amounting to £5·3 million worth of UK goods, including machinery, chemical plant, chemicals, plastics, motor cars and textile products. UK import licences may also be issued for goods up to a total of some £7·3 million. The Czechs have discontinued their own licensing system.

The Hradcany at Prague from across the Vltava

The individual British exporter is presented with another formidable problem: it is virtually impossible to make direct contact with the ultimate user. All trade is handled by state export-import organisations, so that the conventional salesman has no place. The state organisation knows what is required to fulfill the five-year plan and orders accordingly, though a factory can influence the choice to some extent. Unfortunately, Western marketing procedures depend on demonstrating to a potential purchaser that his requirements are not as he supposed. No one can order a product that he does not know exists. But there may be ways of overcoming this difficulty, and in the course of this article I shall attempt to suggest how it may be done.

It will be apparent from the foregoing that any expansion in trade must depend on an increase in earnings from the sale of Czech equipment in the sterling area. What has Czechoslovakia to offer? Perhaps the simplest answer is to describe briefly the main Czech exhibits at the Brno Fair.

WHAT THEY HAVE TO OFFER

The machine-tool exhibits of the Strojimport foreign trade corporation were divided into two groups; cutting or chip-forming machines and machines for forming by heat or pressure. I was assured that the central aim of the Czech metalworking industry was to increase forming processes at the expense of cutting, so minimising waste. Nevertheless, there was an impressive range of metal-cutting tools, many of which were automatically controlled. Among these was the FRP12 surface milling machine controlled by punched 35 mm cinema-type film. The machine tool itself was of unit construction, and what was virtually a range of more than ten different millers could be constructed from the same set of components. The Czech machine-tool industry has entered the automation field in a big way, partly as the result of the country's need to conserve manpower with the departure of 3 million Germans after the war. At the Tos factory in Kuřim, I saw machine tools and their electronic control apparatus being assembled side by side, though so far valves, not transistors, provide the electronic elements.

Of metal-forming machines, one of the most impressive was an LKP 400 crank press designed for the cold extrusion of steel. Strojimport, in spite of its name, also handles the *export* of

machine tools. It may be significant that in the past Czechoslovakia has exported to Britain more machine tools than Britain has exported to the Czechs. The products shown by other trading organisations are indicated in the table, and included Skoda and Slavia diesel plant (Strojexport), and complete industrial installations, package power stations, and a mobile skating rink (Technoexport). Unicoop is a cooperative corporation representing smaller manufacturing organisations.

Some of the equipment mentioned above will be described in greater detail in subsequent issues of ENGINEERING. Consumer goods also represent a substantial fraction of Czech exports, from shoes to costume jewellery and exquisite Bohemian pottery and glass.

WHAT THE CZECHS WILL BUY

Once Czechoslovakia has the necessary sterling, what will she want to buy? A Czech delegation to Britain recently discussed details of their five-year plan with representatives of British engineering companies. They stated that they proposed to enlarge their engineering industry by 72 per cent during the next five years. Their principal requirements would be in foundry and forging plant, railway workshop equipment and machine tools for truck and tractor manufacture, notably gear-cutting machines and grinders.

Also by 1965 the Czechs plan to solve their housing problem, I was told in Brno. Already they are building large prefabricated blocks of flats from precast slabs, with whole concrete staircases as single units. They are therefore planning to expand their cement, plastics, rubber and foundry industries to meet this need, and to do so will be seeking plant from overseas. Stone-Wallwork Limited have already secured a contract worth over £100,000 for foundry equipment, including automatic core-making and shakeout machinery.

I contacted various British exhibitors to determine what equipment was selling well. Henry Simon Limited told me that they expected to be successful with the Simon-Hooper range of corrugating machinery, and were also showing a plant layout for the production of animal feedstuffs (Czechoslovakia is a net importer of agricultural produce). The Czechs had also displayed interest in the company's container-making machinery. The country was already extensively industrialised and might well be in a position to expand her consumer market before some of her neighbours. Food processing machinery, particularly for fruit juices, is being sought, the APV Company reported.

Special-purpose equipment tends to be well received and the Simon Hydraulic Platform had attracted much attention, as had the Sulby Bindmaster for producing books on a large scale without sewing; several have already been sold. Both companies were optimistic about future business.

Anderson Boyes and Company and British Jeffrey-Diamond stated that special-purpose coal mining machinery was in demand—wherever seam conditions corresponded to those in Britain.

Instruments were particularly in evidence. I saw about 30 people crowded round a Solartron data recorder half an hour after the exhibition had closed. Unicam Instruments Limited saw excellent prospects for their SP 700 ultraviolet-visible and near-infrared recording spectrophotometer. Such equipment is scarce in Czechoslovakia. A Tos engineer told me that they were delighted with their Talysurf machine and now proposed to buy a Talyrond. Dynamometers had already been sold by Heenan and Froude. But there seem to be pitfalls. I was told, for example, that ultrasonic apparatus was particularly wanted. But I was driven far into Slovakia to see a research establishment where a wide range of ultrasonic apparatus was under development. Where demand is excessive the Czechs evidently take steps to provide for themselves, so that a good market may vanish unexpectedly.

Consumer products present in strength came from the motor industry. The British Motor Corporation, the Ford Motor Company and the Rootes Group had models on display. Rootes stated that a repeat order for 500 Hillman Minx saloons had been received from Motokov. Money is available but cars are in short supply: there is a two-year waiting list, and popular models are sold on a quota system. They are also awarded as prizes in the state lottery. I was told by one of my interpreters that the trade unions allocated cars to good workers.

Selling to Iron Curtain countries is a skilled job and there are organisations which specialise in advising and assisting those who wish to do so. But first it may be useful to know how business is conducted. The Czechs like to specify their requirements in considerable detail and are at pains to secure the best possible terms.

I put four questions to my hosts: (1) What governs the decision to trade at a given price? (2) When do the Czech authorities decide to buy from the West rather than make the product internally? (3) How do they determine internal prices, for example, between stages in the production process? (4) How do they check economic costing?

PRICE MECHANISM

The answers are linked, though I cannot presume to understand them. I will merely repeat what I was told. I asked several people, including the director of the Tos machine-tool factory at Kuřim. He told me that the cost of any product included items for materials, productive labour, administrative labour, factory overheads and a percentage for profit. This profit was fixed by the ministry for any given process or plant and was used for reinvestment. At Tos a maximum of 3 per cent had been allowed. Apart from this percentage, the factory determined the prices of its products. The ministry, in this case the Machine-Building Ministry, bought from the factory at this price and resold at a price decided by the State Planning Commission in consultation with the customer. Prices are pegged, with the ministry as middleman.

In general, purchases are only made abroad when the item is not produced at home, or not in sufficient quantity. If the item is made at home but more expensively, then pressure is applied to reduce the cost, either by cutting the profit percentage, or in desperate cases by an injection of capital from the ministry. Strojimport watches foreign prices, with this in view. But self-sufficiency is no longer the prime aim of Communist planning.

Strojimport also acts as the intermediary (in place of the ministry) for sales or purchases abroad, though prices in this case are the competitive prices in Western markets. To some extent there is feedback from these prices to the home producer, but variations in home prices are only permitted at regular intervals.

In buying from the West, shortage of sterling often leads the export organisation to seek a barter deal, though it is less true of Czechoslovakia than other Eastern European countries. The Rootes Group is reported to have secured a £250,000 order for cars by offering to buy £15,000 worth of Czech machine tools and timing chains for £30,000, with the balance in cash. But the reason in this case was probably less a matter of sterling than the Czech desire to gain a foothold for machine-tool sales in an important Western industry. Tied deals of this kind are becoming less common.

All sales are one-off transactions; continuing sales are rare, though occasionally, as in the case of Rootes, a further purchase may be made. Nor is it possible to predict next year's business on the basis of past experience. Often a contract is merely intended as a trial.

The Czechs always pay in sterling. Once a contract has been negotiated and signed, they never default and there are seldom supplementary troubles.

HOW TO SET ABOUT IT

Organisations with an interest in promoting Anglo-Czech trade include the state organisations listed in the table. But there are several bodies in Britain who are prepared to help. There is the Board of Trade, whose booklet *Hints to Business Men Visiting Czechoslovakia* has proved valuable to many. The British Board for the Promotion of Foreign Trade assists in organising United Kingdom participation in the Brno Fair. The London Chamber of Commerce has a growing Czech section, which can provide exhaustive background information on trading questions. Exico Limited, which handled a large group of UK exhibits, is a British export-import firm with a Czech managing director. Specialising in Czech business, Exico is an organisation with long experience and inside knowledge of Czech trading practice.

But ideally the British exporter wants to meet his customer. How can he put his products over?

The Stone-Wallwork sale of foundry equipment mentioned above was the culmination of over four years' work, beginning with lectures in Prague and Brno, visits of technical delegations to foundries in Great Britain and finally an exhibit at the Brno Fair. The exhibition itself provides the opportunity for a first reconnaissance where sales engineers can meet their opposite numbers. Another approach, which I certainly found effective for getting into Russia, is to invite an engineer from a complementary industry to visit Britain on an exchange basis. Contacts can then be made on foreign ground. Trade delegations have visited Czechoslovakia, invited factory managers to film shows, and distributed sales literature, with some success. British Embassies in Iron Curtain countries can sometimes supply the names of factories and the all-important research institutes which often guide the operations of an industry. Literature (in English) can then be forwarded.

But initially it is desirable to approach the relevant trading corporation, for, although a factory can influence the choice of plant, it cannot negotiate the sale.

Czechoslovakia, I believe, is being developed as a trading bridgehead with the West. The Czechs are anxious to extend their trade with Britain. We should be churlish to rebuff them.

TABLE:—*Czechoslovak Foreign Trade Corporations*

CHEMAPOL—Panská 9, Prague, 3: Import and export of chemical raw materials and products; rubber; mineral and lubricating oils; pharmaceuticals.
FERROMET—Opletalova 27, Prague, 3: Import and export of metallurgical products; rolled material; wire and wire products; forgings, pressings, etc.; special steels.
KOVO—Tř Dukelských Hrdinu 47, Prague, 7: Import and export of precision engineering products. Electrical equipment—radio and television—telephone equipment—medical and dental equipment—optical instruments—textile and footwear machinery.
METALIMEX—Stepanska 34, Prague, 2: Import and export of ores, metals and solid fuel—precious metals.
MOTOKOV—Tř Dukelských Hrdinu 47, Prague, 7: Import and export of vehicles and light engineering products—agricultural machinery—domestic and household appliances—hand tools—equipment for bakeries and confectionery.
OMNIPOL—Washingtonova 11, Prague, 3: Import and export of sports and transport aircraft and sports and hunting arms and ammunition.
STROJEXPORT—Vaclavské Naměsti 56, Prague, 2: Export of machines, including diesel and electric plant.
STROJIMPORT—Konviktska 3, Prague, 1: Import of machines and industrial plant; heavy electrical engineering—chemical, paper and food industries—machinery for the production of glass, ceramics and cement—machine tools—contractors' plant. Also exports machine tools.
TECHNOEXPORT—Vaclavské Naměsti 56, Prague, 2: Export of complete industrial plants.
ČECHOFRACHT—Na Příkopé 1, Trague, 1: Transport and freight.
METRANS—Na Příkopě 8, Prague, 3: International forwarding.
POLYTECHNA—Politekých Vežňu 7, Prague, 3: Technical Cooperation purchase and sale of patents—conclusion of licence agreements.
TRANSAKTA—NaMustku 1, Prague, 1: Intermediary for compensation arrangements.
TUZEX—Rytiřska 13, Prague, 2: Retail sale of goods in Czechoslovakia for foreign currency.

Earth-Covered Reservoir Has Shell Roof

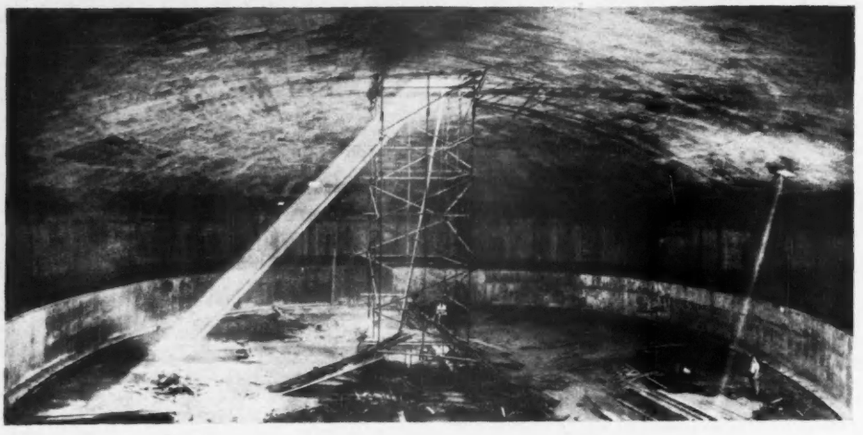
The St. Leonards Hill Reservoir, which forms part of an improvement scheme for the supply of water to the Royal Borough of Windsor, is believed to be the largest earth-covered reservoir yet built with a concrete shell roof. For planning reasons and to maintain the amenities of the area, it has been necessary to cap the reservoir with earth so that it can be grassed to form part of the hill and so blend with the surrounding scenery. The consulting engineers Sandford, Fawcett and Partners of London, decided that the most economical solution was to be found with a prestressed concrete structure covered by a reinforced shell concrete domed roof. The form of construction is illustrated in the accompanying photograph. A particular problem proved to be the phasing of the prestress.

The reservoir is circular in plan with an internal diameter of 160 ft, to give a capacity of 3 million gallons with a depth of water of 24 ft. An interior wall of 120 ft diameter and 10 ft high enables part of the normal storage to be retained so that a supply can be maintained while the reservoir is emptied for inspection, cleaning and maintenance. The walls and the ring beam were precast in one piece in panels 9 ft wide by the full height of the wall on the floor of the reservoir and then lifted into position by a purpose-built gantry. Under the action of the horizontal prestress, applied after erection and jointing, the panels behave like the staves of a barrel.

The function of the reservoir is to store water in periods of low demand and to feed it back into the distribution system at times of high demand, thereby evening out the rate of abstraction from the wells which are unable of themselves to satisfy the peak rate of consumption. Sir George McNaughton, lately chief engineer of the Ministry of Housing and Local Government, inaugurated the scheme on 15 September.

The contractors for the reservoir were Holst and Company Limited of 46 Clarendon Road, Watford, Hertfordshire.

The interior of the St. Leonards Hill reservoir near Windsor. It is believed to be the largest yet built with a shell roof to be earth covered.



Indus Treaty Clears Way for Mangla Dam Project

The agreement of the Water Treaty between India and Pakistan signed on 19 September, 1960, removes one of the major obstacles which have delayed a start being made by the West Pakistan Water and Power Development Authority on their important and long-planned Mangla dam project. This project involves the construction of a large reservoir on the River Jhelum to store water for irrigation as well as for hydro-electric power. The dam site is on the River Jhelum about 57 miles from Rawalpindi.

It is expected that the project will be financed from a fund administered by the International Bank for Reconstruction and Development.

Construction is likely to start in the second half of 1961 and will take seven years to complete. The consulting engineers are Binnie, Deacon and Gourley of London in association with Harza Engineering Company International of Chicago and Preece, Cardew and Rider, also of London.

The principal structure to be built is an earth embankment which will rank as one of the largest in the world, with a maximum height of 370 ft and a crest length of approximately 11,000 ft, requiring 75 million cu. yd of fill.

The reservoir spillway will have an exceptionally large discharge capacity of 1,200,000 cu. ft per second. Six tunnels, each of 28 ft diameter and 2,900 ft long, will convey water to the power station which will have an ultimate generating capacity of 900 MW. Initially it is proposed to instal four 75 MW turbo-alternators.

Is Too Much Cement Used in Road Concrete?

The stiff mix concrete generally used for road works in Britain, particularly on works of small size, leads to difficulties in obtaining a surface with a good riding quality. In America, wetter and more workable concrete is generally employed with entrained air, while on the Continent of Europe richer mixes with higher sand contents are commonly used.

To test this point, the Road Research Laboratory, as noted in the director's last annual report*, arranged for a full-scale investigation to be carried out at Harlow New Town in Essex. Twelve different mixes were tried, ranging from ones similar to those used in America to some comparable to those used on the Continent. Among the tested mixes, the water/cement ratio was varied from as little as 0·38 to as much as 0·515 and the added air varied from nil up to 3½ per cent. Unfortunately, the report does not state if any conclusion was reached with regard to the optimum mix for road work, but it is noted that the riding quality was generally good throughout. This good riding quality was attributed to the use of efficient spreading and compacting machines. Throughout the job, the concrete was compacted in two layers and the compacting machine used for the top layer had a finishing beam that was supported between two bogies to minimise the effect on the riding quality of the irregularities in the formwork.

The use of compacting machines modified in this way had been suggested in *Road Research 1958* and, during the year under review, experiments were put in hand to measure the improvement obtained by so modifying the machines.

For one particular site the average irregularity index before modification was about 48 in per mile and this figure was reduced to about 33 in per mile when the suspension of the finishing machine was changed. With the modified finisher the irregularity index varied between 20 and 50 in per mile but with only 15 per cent of the values greater than 40 in per mile. Before the machine was altered, however, no less than 80 per cent of the indices had been in excess of 40 in per mile. The Laboratory are thus well justified in pointing out the importance of employing machines that have been built or modified so that the finishing bar is slung from between pairs of bogies, at least for all major concrete road construction.

Another full-scale test undertaken by the Laboratory was located at Whitchurch in Glamorgan and was concerned with the mix proportions of lean concrete best used as a base for an asphalt topping. It had been suggested that the cracking in asphalt surfaces might be less if the cement content in base were reduced and that this might be accomplished without sacrificing the load-spreading properties of the base. For this reason mixes leaner than 1 : 15 had become common. At Whitchurch the mixes were varied between 1 : 35 and 1 : 14, the aggregate being crushed 1½ in sandstone. The results of the investigation, as a road test, are still not available but from tests made on samples of the concretes a number of observations were made.

The higher cement content gave mixes that had a higher flexural strength and a greater crushing strength, the former suggesting a reduced liability to crack under load and the latter being indicative of a higher resistance to internal abrasion at cracks. The smaller cement content, on the other hand, decreased the modulus of elasticity, which would mean a reduction in thermal stresses and a lowering of the loading stresses; it would also allow larger deformations to occur before cracking took place, because measurements showed that the leaner mixes took a greater strain at 95 per cent of the ultimate strength than did the richer mixes. The result of the road test under traffic will clarify the relative significance of these several factors in determining the best mix for such work.

* *Road Research 1959*, Published for the Department of Scientific and Industrial Research by HMSO. (7*s* net.)

Human Element

16 Points for Industrial Peace

TEAM WORK, responsibility and opportunity are the keynotes of the British Charter of Industrial Relations put forward by the National Union of Manufacturers.

The NUM's sub-committee, led by Sir William Robson Brown, M.P., has interviewed, thought, and drafted since last May to produce a 16 point charter which, by redefining the targets and principles for both management and unions, may do a great deal to improve the practical efficiency of industry.

The sub-committee aimed to secure three objectives with its charter:

Industrial Peace

Expanding Trade Abroad *and*

Rising Living Standards at Home.

Losses to industry from strikes, go-slows, work to rule manoeuvres and all the rest of the paraphernalia of industrial bad temper and inability to agree are very much more than simply the cost of output that should have been forthcoming. The confidence of overseas buyers is rocked by the attendant publicity. Shipping schedules are disrupted with serious effects on delivery dates. The relations between all levels of management and the men and their shop stewards can be disturbed by a strike in a way that takes months to remedy.

The NUM's sub-committee members declare "We need a new spirit in industry." This is equally true in workers' relationships with each other and with their union representatives as much as between workpeople and management. The observations by Sir William Robson Brown and his three colleagues, that only harmonious and satisfactory working relations are good enough in the speedily changing world of industrial development, have been borne out by a number of incidents reflecting no particular credit either to management or men. There have been sudden declarations of redundancies associated with company changes that could have been the subject of advance notice. There is a sorry record of unofficial opposition from the men to the introduction, or to its best possible use, of new equipment and methods.

Respecting Union Authority

The charter is designed to bring all those in industry into a working partnership. The most obvious point at which such an arrangement is at present breaking down is at that critical juncture where the rank and file feel themselves free to disregard arrangements properly negotiated between their elected leaders and their employers.

On this point Article 5 of the Charter says clearly that the unions must be respected by their members. In the next article the sanctity of all agreements in industry is declared absolute. With the recent example of the members of the National Union of Seamen in prolonged battle with their own executive, and with the still-active unofficial shop stewards' in the electricity supply industry freely calling "national meetings," this is plainly the thorniest problem waiting to be solved.

Some of the recommendations for implementation of the charter will require more than union and management action to bring it into effect. The NUM advocates legal employment contracts incorporating a reasonable period of notice—preferably a month. This would imply that an employee could not break his contract by going on unofficial strike without risk to his security. Explaining their views on this the sub-committee say that it cannot be expected that a person should give loyalty, respect and efficient service if he is aware that at any moment he can be paid off and his life thrown into chaos.

The views of managements, whose production policies and sales have frequently been thrown out of gear overnight by government manipulation of Bank Rate and of hire purchase regulations, would be most interesting on this point. Less readiness by the authorities to take steps which drastically upset the whole market in attempts to balance the indifferent export achievements would make it a great deal easier for firms to maintain long and uninterrupted periods of employment.

On redundancy, the NUM, describing the organisational machinery that would be needed to make the Charter work, says that changing industrial patterns will cause some local dislocation of employment but that we, in Britain, ought to be able to find a sympathetic and effective way of dealing with it.

A much closer coordination between individual companies and local Employment Exchanges on redundancy problems is suggested. There have already been cases of consultations with officers of the Ministry of Labour with the object of finding alternative jobs when considerable redundancy has been imminent. The NUM would like to see this the usual practice.

The system practised in a number of industries, of compensation based upon the length of service of employees who become redundant, should be extended.

It is perhaps reasonable to ask whether the British Charter of Industrial Relations may not be one of the last chances for better worker-management relationships to be discussed in Britain without a background of demands for legislation.

One of the bases upon which the Charter has been drawn up is the assumption that there will be a maximum of voluntary cooperation. Weighing up the merits of legislation to obtain the honouring of agreements and the avoidance of strikes against the voluntary system of conciliation and arbitration, the NUM believes voluntary methods to be "best suited to the British character." Given goodwill it is believed that the system can succeed.

CHARTER OF INDUSTRIAL RELATIONS

1 The dignity of the individual in industry must be recognised and at all times preserved.
2 The individual must accept his responsibilities as part of a team, both in his company and his union.
3 The responsibility and authority of management must be respected.
4 The responsibilities of trades unions to their members must be recognised and respected.
5 Trade union members must respect their own union. Intimidation and victimisation of loyal union members must be barred as a means of settling domestic union grievances.
6 The sanctity of all agreements made within industry must be absolute.
7 Management must clearly define and make known its policies and procedures for dealing with all matters directly affecting employees at all levels.
8 Possible effects on all persons employed should be fully considered before any decision involving them is made.
9 Management should ensure that both unions and employees are kept adequately informed of facts and circumstances affecting the affairs of both the industry and the company.
10 The physical conditions of work should be such as to ensure the highest standards of personal safety, and the mental well-being of all engaged.
11 Every employee should feel he has opportunity and encouragement to train and qualify for up-grading and progressive promotion. Regular opportunity must be provided for all to contribute such ideas as may further efficiency.
12 General and industrial training of youth must be of the highest possible standard. Industry must recognise that the degree of interest it takes in youth today will directly influence the success of industry tomorrow.
13 Management and unions must conduct negotiations through established channels, and firmly refuse to deal with unofficial strikers.
14 Both in regard to national and local conciliation, any unresolved dispute must be submitted to either an area or a national council, and before such submission, work must be proceeding normally.
15 It is a prime responsibility of the heads of every industrial organisation and union to ensure that continuous, informed and direct contact is maintained with all concerned.
16 The highest moral and social considerations should govern the actions of all concerned in industry.

But, say the sub-committee, "We are forced to admit that if this were to fail then legislation would be inevitable." Apart from the discussion of the Charter by union, management and political figures, it cannot avoid influencing more formal discussions that are soon to be held. This will take place at meetings of a new committee of wide membership which the Government are to set up with a writ running broadly over the whole of industrial relations.

Handling Unresolved Disputes

A revolutionary proposal of the charter for many industries—a few already have been through the revolution—is the setting up of neutral committees to handle local trade disputes. Article 14 proposes that unresolved disputes be submitted either to an area or a national council. The article lays it down that work must be going on normally before the case is submitted.

This would seem to be an article that neatly blocks its own good intentions. For it could well be that the men would be viewing as biased any deliberations by an outside body for which a return to work was a prerequisite.

The absence of effective conciliation in much of industry is described as a grave weakness. Local conciliation councils should exist in every area, says the NUM, and local disputes submitted to them by management or local union officials.

Such councils would be appointed by the Minister of Labour and would be made up of equal numbers from management and the unions presided over by a neutral chairman. The sub-committee propose that the committees would meet within seven days of a dispute being referred, would be given facilities to visit the factory concerned and should reach their decision within a month.

Victimisation, one of the most unpleasant aspects of disturbed industrial relations at any time, and particularly since the War, should also be within the province of the committees. An individual, whether allegedly victimised by his fellow workers or the management, should have the right to submit his case.

Not every worker on the factory floor can become a supervisor. But it is important for morale that the man who wants to progress shall not be denied the opportunity, or shall not have to move his job in the attempt. Article 11 of the Charter, laying it down that all should feel they have opportunity and encouragement to qualify for up-grading and promotion, goes on to say that provision should be made for all to contribute such ideas as may further efficiency.

The Charter wholeheartedly backs the best possible general and industrial training of young people (Article 12). Since it has been circulated to the NUM's 4,000 members, a high proportion of whom have indicated that they are willing to make a start with putting it into practice right away, it may be reasonable to hope that some of the resistance to day release encountered from some small firms will begin to melt away.

The Technical Foundations for Nigeria

In the last 15 years technical and professional education, largely British inspired, has been firmly established in Nigeria. Basically the wealthiest country in Western Africa, Nigeria has an urgent need for improved communications.

By C. A. Hart, C.M.G., D.Sc.(Eng)., M.I.C.E., T.D.
Lately Rector and Principal, Nigerian College of Technology

ON 1 October the Federation of Nigeria achieves independence and becomes a member of the British Commonwealth.

Under British influence and guidance a population of varied races and origins has been led from the primitive state of affairs which existed early in this century by economic development and education to the present time, when independence has every chance of success. During this short British period, the country has been opened up, health and other public services established, agriculture stimulated and educational facilities provided at all levels. And a sure position has been secured in world markets.

The educational pattern has been developed logically over the years, the Mission Schools as well as official organisations playing a very important part, as indeed they still do. Most of the population had first to be persuaded, and particularly so in the Muslim North, that education in the Western sense was worthwhile and necessary for advancement. The concept of the modern mechanical age has been but slowly absorbed by peoples who, for example, had not used the wheel until it was introduced from outside comparatively recently.

In this connection it is interesting to note that even today, with students coming from remote villages into institutions of higher education, Chaucer is a very popular author for the study of English literature. He depicts a way of life which is familiar and understood!

Since 1945 intensive development has been greatly aided by generous financial contributions from the British taxpayer in the form of Colonial Development and Welfare (CD and W) Grants to the extent of £40¼ million directly to Nigeria. This does not include millions of pounds more provided by way of central services in UK scholarships, training schemes, educational advisory services, surveys, research, and so on.

NIGERIA IN THE AFRICAN SCENE

In addition to extensions in communications and services, with great advances in general technical education, university and professional education at the highest level has been made available in Nigeria. Most of those who have been actively concerned with this training would have wished for another ten years or so before independence was granted to provide an adequate cadre of Nigerians who are themselves experienced university graduates, professional persons, technicians and craftsmen. There is already, however, a fair number of Nigerians adequately trained to take leading positions, and the supply is rapidly increasing. If the present progress is maintained with the aid of competent expatriates, Nigeria will be enabled by the efforts and contributions of her own people to maintain a leading position in Africa. But the problems and difficulties ahead should not be underestimated, and not least of these is the temperament of the ordinary people who, living in the tropics, do not readily accept or attain European standards of endeavour or achievement.

Africa is now the focus of world attention. It is a continent of diverse problems ranging between those of the Congo, suffering from premature independence and those of South Africa where, though very considerable progress has been made in African education to the highest level, the initiative has been firmly retained by the long-settled European population. African problems are often intensified by well-meaning, but usually ill-informed persons who with no knowledge of Africa or the Africans, base their ideas upon a context which they themselves understand. In this way political and social reformers can do much more harm than good.

And what of Nigeria, described by *The Guardian* during the Queen's visit in 1956 as "potentially the leading African nation"? Nigeria, covering one-thirtieth of the area of Africa, has between one-fifth and one-sixth of its population. Four times the size of the United Kingdom, it is entirely situated in the tropics, stretching from the Atlantic coast for some 700 miles northward with a wide variation of peoples and of climates, the terrain ranging from coastal mangrove swamps, through tropical rain forest and rolling wooded country to Savannah which merges northward beyond the borders into the Sahara.

THE BRITISH EFFORT

Nigeria is not a natural geographical area and it is inhabited by a variety of ethnic units, but a fair measure of democratic government has been evolved in a Federal system. Harmony and friendliness has been generated and maintained between the Nigerians and the expatriate Britons working in the country. This has probably been due in large measure to the "Dual Mandate," which prohibited foreign ownership of land while allowing controlled trade by any expatriate. There is this vital difference between what was known as British West Africa and British East Africa from Kenya southwards, since in the former it is the European, and not the African, who lives in a reservation.

The economy of Nigeria is, and is likely to remain, mainly agricultural. The main handicap to production is native cultivation in small holdings, with no large well-organised plantations as elsewhere in Africa; but peasant cultivation is slow to change the habits of centuries.

The Nigerian economy depends upon exports: cotton, ground nuts and tin ore from the north; cocoa, palm products, timber from the south. Hopes of a sizeable oil production have been raised in the Eastern Region, so far the poorest area in natural resources. Effective production of oil, sulphur and vanadium free, is now getting under way and will noticeably improve the economic position, inducing more industrial development. As far as is known so far, the mineral resources of Nigeria are less than those of the Congo or Northern Rhodesia, though tin provides 90 per cent of Nigeria's mineral output and 5 per cent of the world total.

The great bulk of the population lives well away from modern developments—and Roy Lewis in *Sierra Leone* made a comment which still applies, particularly to the illiterate peasants in Nigeria, who are in the great majority: "The common people—the people who have to cut the bush, plant and weed, bring in the harvest and carry the loads—these people firmly believe that to conserve one's health one should expose oneself to as little exertion as possible."

For many generations in an inhospitable climate the common people—and others as well—have had to endure the discouragement of killing and crippling diseases and have avoided exertion. This attitude is not easily eradicated. Despite all that has been done in training in technical skills, and in higher as well as in basic education, there is still only an educated minority who realise the needs, and who have been and are making great efforts to remedy matters. Unfortunately there are still millions who do not appreciate or understand the needs of special skills, and when they have gained a little knowledge, may assess it very highly and sometimes with unfortunate results.

It has proved extremely difficult without enlightened leadership, to induce a sense of responsibility and conscientiousness among workers. Education has not yet succeeded in demonstrating to them the advantages of an existence above subsistence level. The Nigerian has a well-developed sense of leisure and it is hard to interest him in the material rewards of working hard and long. Individual productivity of the Nigerian is generally deplorably below that of the average worker in Europe.

POST-WAR EDUCATION

Despite progress with education in Nigeria at all levels, especially since the Second World War, the majority of the population of some 34 millions are still illiterate peasant farmers.

There is now universal primary education in the Western and Eastern Regions, whereas in 1943 only about 17 per cent of the children were receiving education. The proportion in Northern Nigeria was much less, but has been increasing rapidly and universal primary education has recently been introduced in Kano.

Many internal and overseas scholarships have been awarded by the Federal and Regional Governments as well as by certain other statutory bodies, and the entry of candidates to the two main Federal institutions of higher education, the University College of Ibadan and the Nigerian College of Arts, Science and Technology (usually known as the Nigerian College of Technology) has been accelerated. These institutions were set up after the war, as also was the University College Teaching Hospital.

During the 1930's, serious attempts were made to establish university type education by establishing a School of Medicine and a Higher College at Yaba near Lagos. Unfortunately, those who passed out did not receive the status and remuneration they would have received after a comparable education in the United Kingdom. Consequently these institutions fell into local disfavour and were discontinued, their functions passing to the newer colleges. During the same period a well-equipped technical institute was also set up at Yaba but this is now well established.

Grants of several millions of pounds have been made from CD and W fund towards the cost of the three major educational institutions mentioned above, though it must be emphasised that the major capital contribution and all recurrent costs have been met from Nigerian funds. It was decided that University College (started in 1948 and now having 1,200 students in residence) should cater at first for degree courses in arts, science and agriculture in special relationship with the University of London, and in medicine in association with University College Hospital, London.

It was decided to cover higher technological and professional education generally in the Nigerian College of Technology, which made a small beginning in 1952. This college was set up on the general lines of what is now known in the UK as a College of Adanced Technology, having, mainly for political expediency, three Branches, one in each Region; at Ibadan in the West, Enugu in the East, and Zaria in the North, with the college headquarters at Zaria. Zaria was chosen as headquarters and engineering and architecture located there, to avoid too great a concentration at Ibadan, and that this arrangement helped to bring technology to the Northern Region more rapidly.

Both University College and the Nigerian College had first to provide courses for GCE at advanced level. In the Nigerian College, courses for GCE(A) are run at each branch, and mainly for the students of the region in which the branch is located. The rate of progress and

achievements to date are phenomenal, because it was only in 1954 that, for the first time, any Northern student took an examination in his own Region above ordinary school certificate.

The writer was concerned with professional education in Nigeria for some years and wishes to pay a tribute to university institutions and professional bodies in the United Kingdom who gave their positive help and recognition. Thus by 1959 the engineering degrees of London were established in special relationship with that university and, with the support and encouragement of the three major engineering institutions. The RIBA had also recognised the architectural courses for their final examination. Similar arrangements were in force with such bodies as the Royal Institution of Chartered Surveyors, the Pharmaceutical Society of Great Britain, the Chartered Institute of Secretaries and the Association of Certified and Corporate Accountants.

There are now over 1,000 full-time students in residence in the Nigerian College. The total number of students in institutions of higher education in Nigeria is around 2,200 (in addition to a comparable number of undergraduates overseas and those in teacher training colleges). This is a very small proportion in relation to total population as compared with Europe; but as yet only a comparatively small percentage of the population has received the kind of education which could lead to higher education. The greatest handicap is of course shortage of funds, since to build, equip and run such colleges, which have to be almost entirely residential in Nigeria, is very expensive, and absorbs a high proportion of national income. Recruitment of first class staff, too, has not been easy.

FARMING AND COMMUNICATIONS

Twenty years ago it was considered that developments in Nigeria should be concentrated in agriculture, with the necessary communications and services and some secondary industries.

Schemes of agricultural mechanisation have not, however, been generally successful so far, partly becaue the basic differences between local cultivation and that elsewhere have not been fully understood and partly because the Nigerian, who has little mechanical sense, does not readily maintain equipment properly.

Until recently main communications throughout Nigeria have been by rail; about 2,000 miles of mostly single track. An extension to Bornu in the north-east, some 400 miles in length, is now under construction with the assistance of an external loan of £10 million from the International Bank. This will improve greatly the evacuation of agricultural products from this large area as the other routes have done elsewhere in the territory. The Regions are connected by rail with the ports of Lagos and Port Harcourt. It is interesting to note that the sea distance between the two ports is 315 miles, while by rail, necessarily via the Northern Region, it is 1,300 miles. Road systems until recently were mostly centred upon the provincial capitals, or fed rail heads or river ports, except in the South. Until recently, these roads have been mainly laterite surfaced and often impassable in the wet season. A very considerable mileage of all-weather trunk roads has been constructed and tar surfaced in the last few years and the progress continues.

Until the railway was brought through to the North just before the First World War, communication with the North was by river transport up the Niger to Lokoja (once the capital) at the confluence of the Niger and its main tributary, the Benue. Thence transport was mainly by head load. Although there have been so many improvements in road communications, and the local air services have been introduced, pack and head-loaded transport is still widely used throughout Nigeria. In the Middle Belt area, where the tsetse fly prevails, head loading is commonly used. It is still customary to refer to weights of goods in head-load units of 50 lb!

There has been great activity in recent years in studying the possibilities of improved inland water navigation in the creek areas near the coast as well as for long distance water transport on the Niger and Benue. Across each of these rivers is a bridge crossing carrying both rail and road traffic and connecting the West and East with the North respectively. A very large bridge project, which will cost some £ millions, to cross the Niger at Onitsha where it is a mile or so wide to connect the West and East, is under active consideration. A direct route via this bridge and Benin between the Federal capital and the Eastern Region is under construction.

Communications by sea are hampered by a coastal bar, continuous from Dahomey to the Niger Delta, except at the entrance to Lagos Lagoon, in which Apapa is the chief port of the country. The second port is Port Harcourt on the Bonny river and where an oil tanker terminal is under construction.

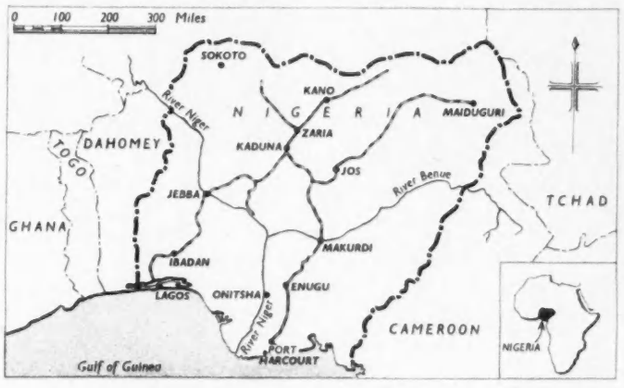
At present industry and manufacturing account for only 1 per cent of Nigeria's income.

Industrial development depends upon the availability of raw materials and cheap and plentiful power. The Electricity Corporation of Nigeria, which has a monopoly, has provided power so far from a series of local power stations. Demand is increasing at a rate above 20 per cent per annum. Coal production, limited to the Eastern Region, is not likely to affect matters much—the annual output is the same as for one day in UK and even this production is already being affected by the competition of oil. The necessary power could be provided in Nigeria by hydro-electric schemes. The importance of study of and research into hydrological problems has been fully realised and much preparatory work has been done, particularly studies on the possibilities of water-power from the Niger and Benue. The head available is small but such schemes are likely to provide both power and irrigation A scheme for the Jebba Gorge on the Niger is being prepared. Such a project would probably be of the order of that at Kariba on the Zambesi in Southern Rhodesia, and would certainly require external finance.

Investigation of the possibilities of heavy industries indicates that these are as yet some way off in Nigeria, even if the necessary skills and raw materials were available. Secondary industries —based upon local products—are springing up, such as textile mills, timber and wood products. A cement works under expatriate supervision supplies a large proportion of Nigeria's needs. Its capacity has doubled to 200,000 tons a year and a second works of similar size nears completion. Plywood production has now become an important item. Some margarine and soap is manufactured by a Unilever subsidiary and there are other activities such as fruit canning, a brewery, tyre-retreading and so on, but the degree of industrialisation is hardly noticeable.

(Right) A Nigerian worker in the Jos depot of the Shell Company of West Africa.

(Below) Nigeria has a great need for better communications — and the Niger and Benue, if controlled, could provide good water routes.



Nigeria is thus just on the threshold of industrial development and for a long time some industries may well be introduced more for prestige reasons than for expectation of economic success. The export of crude oil for the first time in 1959 reached 600,000 tons and the setting up of a refinery is under discussion. Effective production of oil will enable industrialisation to be accelerated. Meanwhile the prosperity of the country and its inhabitants can be advanced by concentration on agriculture with extension of communication, power and health and social services. In addition to extensive schemes for Trunk Roads, some already under construction, the Regional Governments are also planning to improve and build many local roads. Water resources are being carefully studied and piped water supplies proposed for a number of towns. Telegraphic and telephone services are being improved by radio installations.

Nigeria does not yet have the necessary skills or funds to run her major expatriate-owned businesses but there is undoubtedly a great future for the country's development in which, as skills and experience are gained, Nigerians themselves will play an ever increasingly important part.

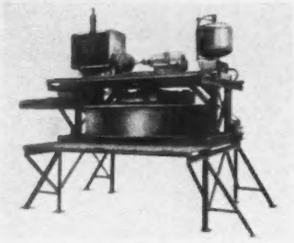
MIXER

For Concrete or Soils

A STATIONARY horizontal mixer has a batch capacity for unmixed material of 42 cu. ft and 28 cu. ft mixed.

The 42/28B Gyramixer is a pan type unit developed for the high speed mixing of concrete to any specification. It will also handle soil stabilisation mixes. A maintained output of 60 cu. yd per hour can be achieved, every batch being fully mixed in about 20 to 30 seconds. A full 1 cu. yd. batch is completely discharged in 15 to 20 seconds.

The stationary pan forms an integral part of the rigid base structure and is made of alloy steel. The mixing unit comprises a rotating gearbox which revolves about the centre of the pan. It carries two stars each rotating about its own axis and fitted with three blades. Floor and wall scraper blades are also attached to the rotating gearbox. The stars rotate at unequal radii to cover the whole floor area. The blades are rigidly mounted on arms which are attached to the rotating stars by rubber torsion bushes.



Power is supplied by a totally enclosed squirrel cage motor of 35 h.p. Alternatively a 38 h.p. diesel engine can be fitted. The drive is taken to the mixing unit through a helical spur reduction box and a layshaft incorporating Hardy-Spicer universal joints, to a Radicon worm reduction gear.

The pan measures 8 ft 9 in diameter by 1 ft 8 in deep. The gearbox rotates at 11 r.p.m. Operation of the discharge gate is pneumatic. Water is supplied from a vertical 35 gallon tank, measured out by an adjustable syphon. A power loader is available to work with the mixer. *Blaw Knox Limited, 94 Brompton Road, London, SW3.*

CRAWLER CRANE

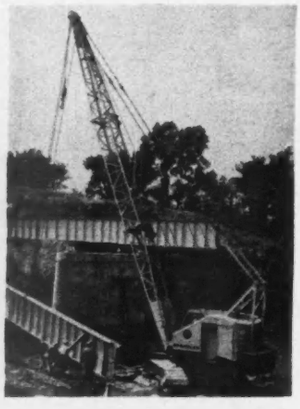
31½ Ton Capacity

BUILT-IN swinging outriggers are a feature of the new 545 Sprawler mobile crane, now being made in this country.

The design of the machine is for a high lifting capacity with light construction. The basic boom length is 40 ft using a lattice type boom and bolted connections. With this boom at 12 ft radius the crane will lift 31·5 tons with the outriggers set, and 24·5 tons standing free on the tracks. The boom can be extended to a maximum length of 120 ft, and 30 ft jib boom extensions are available for use on main booms up to 100 ft in length.

With a 40 ft boom the crane weighs 35 tons, which is reduced to 23 tons when the boom and counterweights are removed for travelling. Other features include a self-lowering high "A" frame which reduces the overall height of the crane to 12 ft 5 in; a counterweight removal device for low loader travel; power controlled boom lowering and power controlled load lowering.

Power is supplied by a Dorman 6LC



engine developing 100 h.p. Alternatives are Rolls-Royce, Cummins, Leyland and Gardner engines. Crawler shoes 36 in wide reduce the ground loading to 7 lb per sq. in and with the outriggers swung in the overall width is 11 ft 8 in. *Newton Chambers and Company Limited, Thorncliffe, nr. Sheffield.*

STACKER

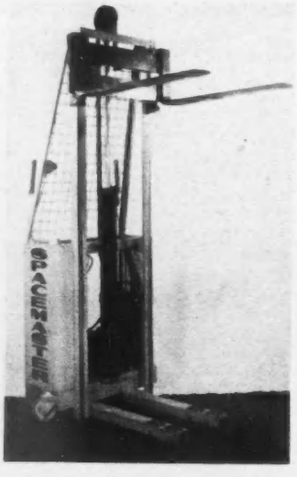
For Narrow Gangways

AN extremely small turning circle and high lifting speed are two features of the Spacemaster stacker.

The machine is available in three lift capacities of 8 cwt, 10 cwt and 15 cwt. All have the same lift height of 5 ft. The forged steel forks can be either 30 or 36 in long and the feet can be straddled, as in the illustration, or spaced up to 53 apart. In the standard models the overall height and width allow the truck to pass easily through normal doorways.

Power is normally supplied by batteries with a guaranteed life of four years, but models are also made for hand hydraulic or mains operation. A safety overload valve is incorporated and elevation and variable speed controls are grouped to give the operator full control whether the truck is in motion or stationary.

A variety of attachments is available for use with the stacker including platform plate; multipositional boom with sliding hook; drum or skip rotating units; drum lifting forks; roller platforms and floor brake. *Bishop (Birmingham) Engineering Company Limited, 162 Orphanage Road, Erdington, Birmingham 24.*



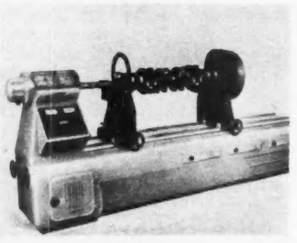
BALANCING MACHINE

Components 80 in long

NOW available in this country is the Rava range of Komposition dynamic balancing machines.

The model illustrated is the K300 which has capacity for parts up to 40 in diameter and 80 in long weighing as much as 660 lb. The workpiece is supported on rollers in the pedestals, which are hung from vertical straps and are free to swing like pendulums. The drive to the workpiece is by a universal jointed shaft with adaptors to suit the item, and protective straps are incorporated to prevent a component being thrown out of the machine.

The instrumentation gives a direct reading, and once the first component of a batch has been balanced, no further setting up is required. An electrical pickup on each pedestal generates a current through the motion of the support and feeds it to a four segment commutator rotating with the drive motor at balancing speed. Two opposite segments of the commutator are for the vertical components of the out of balance



force and the other pair for the horizontal components.

The two pairs of segments feed separately into two direct current meters of the zero centre indicating type. Two polar calculators, one for the left and one for the right plane, are mounted above the instrument panel. Each has controls for the vertical and horizontal lines. The angle indication is given by a graduated line, and circles drawn from the centre give the unbalance value. A graduated disc on the spindle gives the angular references of the unbalance. Models are made for components from 1 oz to 10 tons. *Edward G. Herbert, Limited, Atlas Works, Manchester, 19*

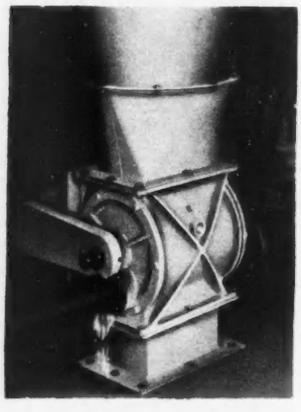
FEEDER VALVE

For Pneumatic Conveyors

TWO types of rotary feeder valves are now on the market designed specifically for use with pneumatic conveyor systems.

Type QNm illustrated is for introducing powdered material into the feed line. It consists basically of a robust casing carrying a chain driven multi-bladed rotor, the driving shaft being carried in roller bearings. Material fed into the pockets between the blades is discharged at the bottom of the casing where the blow line is connected as a through run. Air contained in the empty pockets is discharged through a neutralising port to prevent it from interfering with the gravity discharge of stock from the bin mounted above.

Brass tips inserted in the slots at the periphery of the blades are rubber cushioned at their base to provide a seal and to allow for wear. A shear pin in the drive is provided to guard against damage in the event of accidental jamming of the blades by the presence of some foreign body in the powder.



The type PNm valve is for discharging material from the line to a hopper. The basic construction is the same and the valve has a self-contained motor drive to the multi-bladed rotor. A neutralising port is included to prevent puffing into the bin. *Thomas Robinson and Son Limited, Rochdale.*

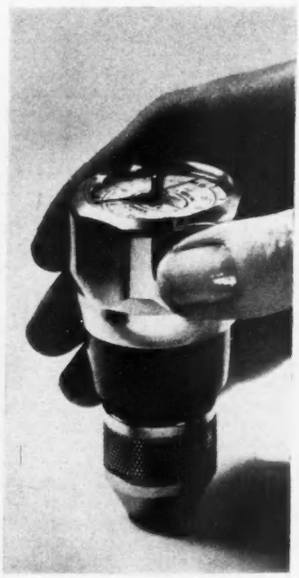
TORQUE GAUGE

For Small Motors

STARTING and stall torques of small electric motors can be measured by new Waters torque meters now available in this country.

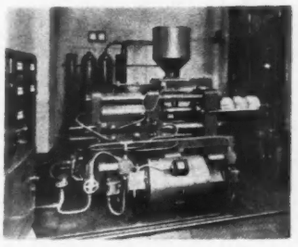
The instrument weighs 7 oz (11 oz if the keyed chuck is fitted) and measures $1\frac{5}{8}$ in diameter by $3\frac{9}{16}$ in long. The standard chuck as $\frac{1}{4}$ in capacity. Three versions are made with varying accuracy; the standard, accurate to $\pm$ 5 per cent of full scale; special to $\pm$ 2 per cent of full scale and another special accurate to $\pm$ 1 per cent of any one specified value. Both bi- and uni-directional models are made.

The dials are fitted with a recording needle to show the highest torque registered and the scales, covering 300°, are enclosed in crystal glasses. The full torque range covered by all the models is from 0·005 to 40 oz-in or from 0·5 to 2,800 gm-cm. Starting and moving torques of potentiometers can also be measured. *International Engineering Concessionaires Limited, 39 Parliament Street, London, SW1.*



INJECTION UNIT

For Vertical Press



INJECTION units are now being made for coupling to a vertical locking press to make a high performance unit for both thermoplastic and thermosetting mouldings.

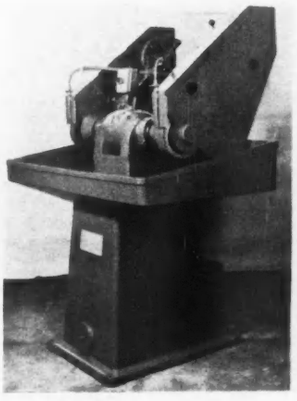
The injection unit has a rugged base containing the hydraulic fluid and with the power unit pump and controlling valve gear mounted on it. The complete injection assembly consists of a hydraulic power cylinder, hopper, feeder, block, and plasticising chamber. It is mounted on precision ground slides and guides and is capable of hydraulic powered advance and retraction so that the heating chamber can be brought into position and withdrawn under button control.

The spreader is designed in one piece with the front cap, the surfaces in contact with thermoplastic material being fluted to give maximum heat transfer. To give additional heating elements have been positioned in the spreader with a controlling thermocouple. It is claimed that the complete plasticising chamber is easily taken down for cleaning, being held by high tensile bolts with precision lapped sealing surfaces.

The connection to the vertical press is made by a throughput tube capable of transporting the material to a turn-round gooseneck, and thence to a standard nozzle situated on the centre line of the platen. Heating and time control is provided. The injection ram has a fast approach and a controlled final squeeze. The units are being made in a range of sizes with capacities from 1½ to 32 oz and arranged to feed presses of the corresponding size. *BIP Engineering Limited, Streetly Works, Sutton Coldfield, Warwickshire.*

BACKSTAND GRINDER

Wet Belt Operation



REDUCTION of fire risk is one of the claims for a new backstand grinder that operates with a coolant supply.

The wet belt operation allows such materials as magnesium to be fettled in reasonable safety. In addition abrasive consumption is reduced and dust extraction equipment rendered unnecessary. Moreover, the work piece is always cool for handling.

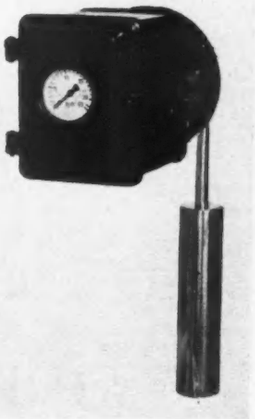
Designed for small and medium size workpieces, the machine has an 8 in diameter contact wheel. The belt length normally used is 60 in and belts up to 2 in wide can be accommodated. The distance between the contact wheels is 2 ft 5 in and the height from the floor to the centre of the spindle is 39 in. The spindle is direct driven with the motor rotor mounted on it.

The machine is self contained, the pedestal forming a large capacity reservoir and pump tank. Beneath the contact wheels is a large splash tray and access to the abrasive belts is obtained through quickly detachable side doors.

The tensioning and tracking arrangement is as used on the firm's dry belt machines with the addition of special sealing for water exclusion. The motor is rated at 2 h.p. and the spindle speed is 2,850 r.p.m. *Taylor Tools and Supplies Limited, Vortex Works, Atlantic Street, Broadheath, Altrincham, Cheshire.*

LEVEL CONTROLLER

Open or Closed Container



A NEW liquid level controller can be used in either open or closed vessels with pressures in the latter up to 900 lb per sq. in.

The system comprises three main units: the displacer, the controller and the regulating valve. An air output signal of 3 to 15 lb per sq. in is generated. The displacer is used to transmit changes in the liquid level. Variations will produce apparent changes in weight which are proportional to the level and are compared with the force of a set point spring. The difference between the spring load and the weight change determines the output of air which is directed to the diaphragm chamber of the valve.

An amplifier can be fitted where the control valve servomotor has a large air capacity or where there is considerable air line capacity between the controller and the valve. In order to provide stable control, proportional band adjustment is provided. At 100 per cent setting the level change will be equal to the maximum level change of the controller which is normally either 8 in or 14 in. At minimum, the level change is 10 per cent of maximum. *British Arca Regulators Limited, Sisson Road, Gloucester.*

DIRECTION FINDER

For Small Craft

NOW available is a fully portable direction finding receiver contained in a single case.

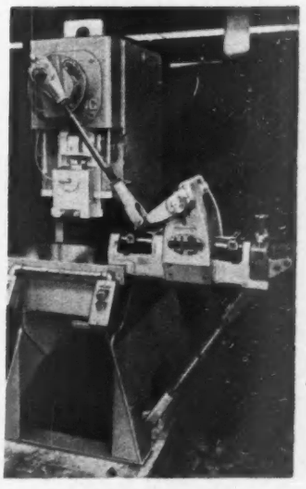
The " Solent " enables accurate bearings to be taken from radio beacons on the long wave beacon band. Sensitivity and selectivity compare favourably with fixed installations and trials have shown that bearings can be taken with an accuracy of plus or minus one degree. A signal strength meter gives visual indication of signals when direction and sense finding, thus giving greater accuracy than the usual audio method. The meter is also used for checking the battery strength.

The direction finding aerial is a ferrite rod mounted, together with a compass rose, on the top of the receiver case. The signal strength meter, full vision dial and other controls are mounted on the front panel, controls having been kept to a minimum for simplicity. Two sockets are provided, one for headphones and the other to take an external aerial for sense finding. This also greatly increases the range of the receiver on the shipping band. A beat frequency oscillator is included to allow long range navigation by " Consol ".

The self-contained receiver employs nine transistors and works off eight standard 1½ volt torch batteries. These features and the printed circuitry make it light, portable and robust. In addition to the long wave band the Solent will cover the medium-short trawler band. An 8 in elliptical loud speaker designed to work in conjunction with transistor circuitry is incorporated. If used for two hours a day the battery life is approximately three months. *Pye Limited, Cambridge.*

SLIDE FEEDER

For Automatic Presses



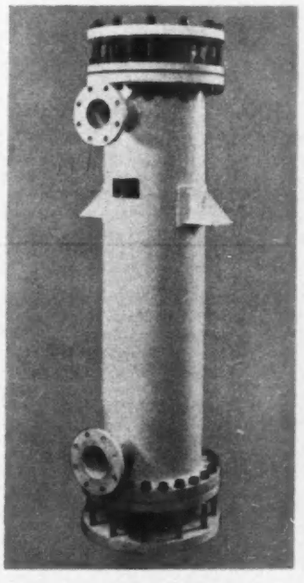
NEWLY designed versions of the " US " slide feeds for automatic presses are now being made in this country.

The illustration shows one fitted to a British Clearing press. There are two sizes to handle stock up to 6 in by ⅛ in or 9 in by ¼ in, the maximum feed lengths being 8¼ in and 9¼ in respectively.

A two piece eccentric mounted on the press crankshaft eliminates location of keyways and allows for timing adjustment on drawing work. The feed length can be adjusted without altering the connecting rod. The slide feeds are symmetrically designed so that the feed block operates from the centre or zero setting. To set the feed length the eccentric is adjusted till the pointer on the block indicates the required length on the scale attached to the body. Where high feed accuracy is needed, adjustable front and rear stops are used to determine the block travel. A drag check is fitted as standard but a roller check can be supplied if desired. This has a clutch on both upper and lower rolls. The height of the blade can be adjusted to suit the material thickness. *Rockwell Machine Tool Company Limited, Welsh Harp, Edgware Road, London, NW2.*

GRAPHITE CONDENSER

For Corrosive Vapours



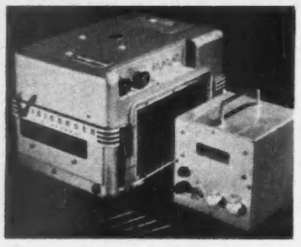
LATEST addition to the range of Delanium graphite heat exchange equipment is a graphite cartridge condenser.

The condenser has been specifically designed for use with corrosive vapours. The graphite element or cartridge is cylindrical in form and is equipped with through holes along the major axes down which the condensing vapour passes. The service fluid passes in counterflow through the annular space between the steel jacket and the slotted outer surface of the cartridge. Carbon inlet and outlet heads complete the assembly.

The steel jacket may be lined with suitable inert material if service fluids other than water are used. Strong mounting lugs are provided for bolting the unit in place. One of the claims is the small size; since 1 sq. ft of graphite surface is equivalent to 3 sq. ft of glass surface the units have a high rating. They are being made in sizes from 4 to 90 sq. ft. *Powell Duffryn Carbon Products Limited, Springfield Road, Hayes, Middlesex.*

OSCILLOGRAPH

Direct Recording



THE model 906B Visicorder is a direct recording oscillograph with up to 14 channels.

The instrument uses a beam of ultra-violet light to make the recording, the recording point being visible. As there is no mechanical contact the traces can cross each other and so the whole width of the paper can be utilised. The record is permanent. On paper 6 in wide frequencies up to 5,000 cycles can be recorded, using two of the channels for reference or timing traces. Intensity control, grid line system and trace identification are provided. A self-starting recording lamp is used, so the instrument is suitable for remote control. There is also a built-in power pack.

There are two versions of the instrument, intended to give interchangeability with existing equipment. One uses high sensitivity plug-in subminiature galvanometers and magnet assemblies, and the other uses the solid frame type. A variety of drive systems is available, all interchangeable and each with a choice of four speeds. There are five ranges: 0·2, 1, 5, and 25 in per second, per minute or per hour, 0·4 to 50 in per second, and 5 to 100 mm per second. The maximum writing speed is in excess of 20,000 in per second.

Trace identification is by a light beam interrupter system with short clean breaks. Grid lines can be recorded simultaneously with the trace at intervals of 0·1 in with wider lines at each half inch. Accessories include a timer, shown in the illustration; relay rack adapters; static reference trace and record take-up units. *Honeywell Controls Limited, Ruislip Road East, Greenford, Middlesex.*

PUMP RAM

Foot Operated

NEWLY added to the range of combined pump units is a foot operated model for general use.

A particular application suggested for the model 200 is incorporation in elevating tables for press tools and the like. Although small in size the unit contains pump, oil reservoir, and ram so that it is entirely self-contained. The flat pump base has tapped holes for mounting, allowing easy and inexpensive installation. The absence of external piping reduces cost and labour.

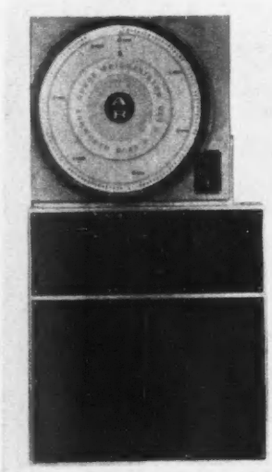
Two ram capacities are available: the smaller is rated for loads of 1,100 lb and the larger up to 1,600 lb. The pump is a single speed unit with a working pressure of 1,500 lb per sq. in.

The force required on the pedal is 60 lb for a theoretical pump stroke of 0·56 in in the smaller, and of 0·36 in for the larger ram size. The ram stroke is made to customer's requirements in the range from 6 in to 47 in. The release control knob can be fitted with an extension if preferred.

The pump is made from a solid block of steel giving great strength, and the ram cylinder is made from seamless steel tube with the bore honed. The piston rod is of high tensile steel ground and plated with hard chromium. *The Linford Engineering Company Limited, Baker Street, Birmingham 11.*

WEIGHT INDICATOR

Automatic Printing



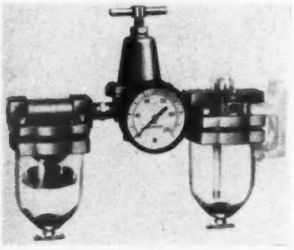
LEGIBILITY of the printed records is one of the features of the new Weighprinter indicator.

The machine is completely mechanical in operation and produces printed records on an external ticket and an internal paper roll. The indicator is available in capacities from 5 cwt to 100 tons and can be fitted to tank scales, dormant scales, and weigh-bridges.

There is a stop-fraud unit that consists of a photo-electric scanning device which isolates the printing motor until the scale is in equilibrium. As there is no physical connection the accuracy is not affected. There are no external manual controls. The operation is started by a push button and remote control of both the range selector and print cycle is possible. Completely automatic operation linked with other units is also possible. When required an electro-mechanical transposing unit may be combined with the decimal printout to give a digitised output in the form of a five channel punched tape, with control of an electric typewriter. *Ashworth Ross and Company Limited, Scout Hill, Dewsbury, Yorkshire.*

AIR CONTROLLER

With Filter and Lubricator



THE Lub-Air-Ator is a combination of three units to control the supply of compressed air to a machine.

The three units comprise a pressure regulator mounted in the centre with a filter on the up stream side and a lubricator on the downstream side. The filter is of sintered bronze enclosed in a glass bowl. A whirling action baffle plate throws any foreign matter entrained in the air to the sides and allows it to accumulate at the bottom of the bowl. Cleaning is carried out by opening the drain cock and blowing the accumulation out. No replacement filters or cartridges are required.

The pressure regulator is rated for inlet pressures up to 250 lb per sq. in and will control the outlet to within the range from zero to 125 lb per sq. in by means of a screw adjustment. It is claimed that the regulator eliminates surges and has a fast response with a low pressure drop.

The lubricator is for supplying a regulated amount of oil to the air supply for moving machinery. The operation is automatic and the pressure drop across the lubricator is small. The oil supply is contained in the glass bowl so that the level is always easily visible. The rate of flow of lubricant is adjusted by a knurled wheel which is claimed to be vibration proof. A wide range of adjustment is possible to cover most normal requirements.

All three units that make up the set can be supplied and used separately and all can be serviced and maintained without disconnection from the air line. Standard connections are fitted. *A. Schrader's Son, 829 Tyburn Road, Erdington, Birmingham 24.*

BENCH MAGNIFIER

With Built-in Light

A MAGNIFICATION of 2½ times is given by the Ellisviewer bench mounting inspection lamp.

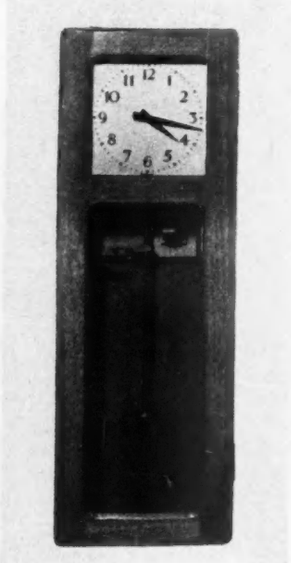
Power for the lamp is supplied from the nearest mains socket and there are two bulbs in the hood. In the hood also is the glass lens of 5 in diameter which may be tilted to any angle, directing the light on the required spot. As the whole head can also be adjusted for height on the main stand, any object can be brought into focus. It is claimed that the viewer is particularly suited for the repetitive examination of similar articles.

The light is controlled by a press button switch mounted in the base plate and a length of plastic covered cable is included. The main column and the hood yoke are chromium plated and the base and hood have a grey polychromatic finish. The large adjusting knobs for height and angle are made in black plastic. The column stands approximately a foot high.

The viewer is essentially a general purpose instrument and can be used wherever there is a need for close inspection. Suggested applications include factory inspection benches, schools, laboratories, and in the medical professions and in such diverse fields as archaeology, and printing and packaging. *Ellis Optical Company, Mayday Road, Thornton Heath, Surrey.*

TIME CLOCKS

50 Slave Dials



A NEW time clock is claimed to be both compact and silent.

The master clock is only 30 in high and is capable of operating 50 slave dials on a single circuit. The number can be increased by the addition of relays, and hooters and time recorders can also be controlled from it. Accuracy is said to be very good.

Features of the master are the Invar ½ sec pendulum with full compensation, and the Hipp system of drive that automatically corrects for low voltage of the supply battery. The standard mechanism gives one impulse per minute of reversed polarity. An advance lever is provided.

The movement of the slave dials is only 1 in thick so they can be enclosed in the bezel, giving a flat mounting unit. The use of reversed polarity has eliminated pawls and ratchets from the mechanism making it silent in operation. A wide choice of dial styles is available. *Minipulse Clocks Limited, 10 Storeys Gate, London, SW1.*

Developments in Research

For two days recently the Atomic Energy Establishment at Winfrith Heath was open to visitors. The rapid development to the extensive programme that is being undertaken at Winfrith makes it very difficult to be strictly up to date with all the latest steps. A survey is given below of the main reactors and subcritical assemblies that are operating or under construction at the establishment.

Dragon

The £13·6 million Dragon project is sponsored by the Organisation for European Economic Cooperation with participation from Austria, Denmark, Euratom, Norway, Sweden, Switzerland and the United Kingdom. The object of the project is to carry out a programme of research and development on the high temperature gas cooled system. The Dragon reactor will have a maximum thermal output of 30 MW, no provision is made for electrical generation. The coolant is helium, pressurised to 20 atmospheres, which enters the reactor at 350° C (661° F) and leaves at 750° C (1,381° F). The high exit temperature indicates that certain parts of the core will be operating at 815° C (1,500° F) or greater.

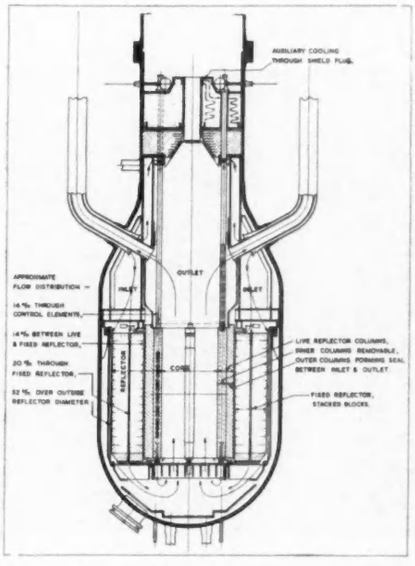

AUXILIARY COOLING THROUGH SHIELD PLUG
APPROXIMATE FLOW DISTRIBUTION —
16 % THROUGH CONTROL ELEMENTS
14 % BETWEEN LIVE & FIXED REFLECTOR
20 % THROUGH FIXED REFLECTOR
52 % OVER OUTSIDE REFLECTOR DIAMETER
INLET
OUTLET
INLET
REFLECTOR
CORE
LIVE REFLECTOR COLUMNS, INNER COLUMNS REMOVABLE, OUTER COLUMNS FORMING SEAL BETWEEN INLET & OUTLET
FIXED REFLECTOR, STACKED BLOCKS

Fig. 1 Sectional view of Dragon reactor core, showing coolant flow pattern.

The fuel is 90 per cent enriched thorium 232 and uranium 235 made up in the form of rings. Six of these rings are placed on a graphite dowel and encased in a cylindrical box 6 in long of semi-permeable graphite; ten of these boxes are then placed in a graphite tube. Clearance is left between the inner wall of the tube and the boxes for the primary coolant to pass which it is hoped will remove most of the escaped fission products. An element is made up of seven of these tubes—six being placed radially round a central tube. There are 37 of these elements in the reactor. The secondary coolant passes on the outside of the tubes with a flow path as shown in Fig. 1. The core is 3·5 ft diameter and 5·25 ft long, and gives a mean power density of 14 MW per sq. cm. The reflector is of high density graphite and is divided into two cylinders the inner of which is removable. Control is maintained by 24 rods of boron carbide contained in stainless steel tubes placed round the perimeter of the core. Fig 2 shows the present state of the civil construction on the project.

Zenith

The zero energy reactor Zenith is fulfilling the same function for Dragon that Zeus filled for the Dounreay fast breeder experiment. The reactor core consists of a nearly cylindrical assembly of 235 fuel elements, 8 ft high and 4 ft in diameter in the form of graphite cylinders arranged in a regular pattern. The fuel is made up of individual pellets containing either uranium 235, thorium oxide or graphite, which can be placed in the cylinders in any desired order or proportion. The reflector is of graphite and the whole is contained in a pressure vessel through which nitrogen gas is pumped at 800° C. The reactor will operate at a peak flux of 10^8 neutrons per sq. cm per sec, giving a maximum power of 100 watts. Control is by 30 control rods in the graphite reflector. The reactor is now loaded with 18 kg of uranium and is checking the reactor physics for Dragon.

Nestor

Nestor is a modified Jason purchased from Hawker Siddeley. It has uranium aluminium alloy in the form of plates arranged in an annular for its fuel and is cooled and moderated by natural water. Control is obtained by varying the level of the water or bubbling nitrogen gas through the water in the annulus. It will operate at a flux of 10^{11} neutrons per sq. cm per second in the centre decreasing to 10^8 in the experimental assemblies; four assemblies may be placed around the periphery of the reactor and one on top of the core. The power rating is 10 kW continuous and it will be used essentially to provide neutron sources.

Nero

Nero is a graphite moderated zero energy reactor which was transferred from Harwell to Winfrith in October, 1959. It is used to investigate reactor physics problems associated with gas cooled reactors. The graphite dimensions, lattice pitches, fuel elements and control rod locations within the reactor core may be varied within very wide limits in order to reproduce the system under investigation. The experiments determine the critical sizes, effectiveness of reflectors, kinetics of power changes and the performance of control systems. Nero also uses the oscillation technique similar to that to be used in Hector which is to be constructed at Winfrith (Atomic Review, 16 Sept. '60). This method is found to give a more precise answer due to the elimination of spurious effects such as atmospheric pressure changes and in effect each oscillation represents an individual reading.

Zebra

The UKAEA have decided to build this new Zero Energy Breeder Reactor Assembly at Winfrith. This may be said to be the stepping stone for the fast breeding reactor that will succeed the Dounreay experiment. Zebra is designed to study fuel assemblies containing uranium and plutonium. The assemblies will be built up of plates 2 in square made of fuel or neutron absorbing material; the latter will be used to simulate the nuclear properties of the coolant and structure material used in a power reactor. Zebra will operate at room temperature and no coolant will be required.

Subcritical Assemblies

Scorpio I (Atomic Review, 29 July '60), is a graphite subcritical assembly and is being used to examine the changes that are brought about by the production of plutonium in uranium fuel as found for example in the Calder Hall type of reactor. The presence of plutonium greatly affects the characteristics of the reactor and this effect is dependent on temperature. To examine this it is necessary to be able to heat the assembly up to 400° C (755° F) for which nitrogen is circulated in a closed circuit loop. Unlike other subcritical assemblies it has been necessary to have complete containment in order to prevent the escape of any plutonium fission products.

Scorpio II is similar to its predecessor but will be smaller and will be used to extend the range of experiments. It will also provide details of local variations of neutron distribution within the repeated lattice units.

The BICEP (British Industries Collaborative Exponential Programme) exponential stack is used for calculating the critical size of a reactor. The graphite bricks are designed so that a wide range of lattice geometries may be produced.

Helen—has thin parallel plates of plutonium aluminium alloy fuel suspended in a tank containing a chosen liquid moderator. It is used for extending the calculation methods for uranium fuelled liquid moderated systems to similar systems employing plutonium fuels. A range of lattice spacings and different moderators can be studied in the system.

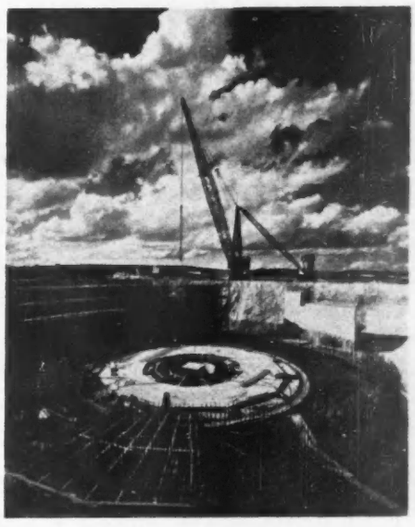


Fig. 2 Progress continues on the Dragon project at Winfrith Heath.

Notes and News

German Research Programme

Next year Germany's largest nuclear research centre will open at Juelich in the Rhineland. The centre will have as its main equipment a a British MERLIN swimming pool reactor and a British DIDO material testing reactor. Both of these are now under construction. Work will begin shortly on a German designed 15 MW experimental boiling-water power reactor, in the construction of which eleven German firms are collaborating under the supervision of Allgemeine Elektricitäts-Gesellschaft of Frankfurt. The hot laboratory at Juelich will be one of the four largest in Europe. It is being designed by Leybold-Hochvakuum Anlagen of Cologne, and will be constructed jointly by this firm, the Lurgi Company and Friedrich Uhle of Dortmund. The laboratory will have two main functions: to examine various types of reactor fuels, and to make a scientific and technical study of irradiated reactor materials. The centre is financed jointly by the Federal Government and the North-Rhine Westphalian Land Government.

Five Other Centres

The Federal Government also has a share in the financing of five other nuclear research centres; the biggest of these is at Karlsruhe which has an FR-2 natural-uranium multi-

purpose research reactor due to come into operation next year. In addition to the Baden-Wurtemberg Land, private industry shares the cost of this station with the Bonn Government. The oldest nuclear research centre is at Munich where the Institute of Technology has a 1 MW swimming pool reactor which started operation in 1957. The other three nuclear research centres all date from 1958. The largest at Geesthacht, near Hamburg, has a 5 MW swimming pool reactor using 20 per cent enriched fuel. Germany's research on nuclear ship propulsion is concentrated at this centre. Shipping and shipbuilding companies share the cost of Geesthacht with the Federal and Land Governments. The research centre at Frankfurt has a 50 kW boiling-water reactor and specialises in the production of radioactive isotopes. Finally there is a small nuclear research centre in West Berlin, which has a boiling-water reactor, and carries out research in radiation chemistry. The new centres at Juelich and Karlsruhe are both on a much bigger scale than the four older ones. They mark a definite turning point in Germany's nuclear development.

present rate continues should be ready for stress relieving by the end of the year. The first of the eight steam raising units for reactor A has just been placed in position. Most of the 9 ft thick biological shield on reactor B has been completed and work is proceeding on the prefabrication of the pressure vessel on the site. The vessel is now up to the equator line *in situ*. Profiting from experience on reactor A, work is two months ahead of schedule. The turbine hall is ready to receive the six turbo-generator sets and delivery is expected next month. It is known that the first estimate of £37·5 million for the station will be exceeded and Mr. A. L. G. Lindley, vice-chairman and managing director of GEC, indicated that the excess may be up to £10 million, which brings the station cost more into line with the other CEGB nuclear stations. Deviations from the original design have been few and these were mostly to facilitate the civil contractors.

Harwell's New Library

A new building housing the main library and the document reproduction section at Harwell was opened on 7 September by Sir Lindor Brown. The library houses a stock of some 20,000 volumes of books, 250,000 copies of technical reports, 50,000 micro-cards and 27,000 pamphlets, and contains the largest collection of atomic literature in the country. Reference and loan services are provided, and extensive reading room accommodation has been included.

Steel Symposium

Contributions from Canada, the United Kingdom, the United States and Russia are expected for a symposium on "Steels for Nuclear Reactor Power Circuits," being held by the Iron and Steel Institute at the Hoare Memorial Hall, Church House, Great Smith Street, London, SW1, from 30 November to 2 December, 1960. The symposium will treat the following topics: factors governing the selection of steels; fabrication aspects; irradiation effects; high-temperature properties and corrosion.

Middlesex Hospital Radiation Course

A four week course beginning on 24 October at the Middlesex Hospital will provide an introduction to the subject of radiation suitable for medical, engineering, chemical and other professional workers who require an overall appreciation of the problems involved in maintaining radiological safety in industry and medicine. The fee for the course will be £40 and application forms may be obtained from the secretary, Department of Physics, Middlesex Hospital Medical School, London, W1.

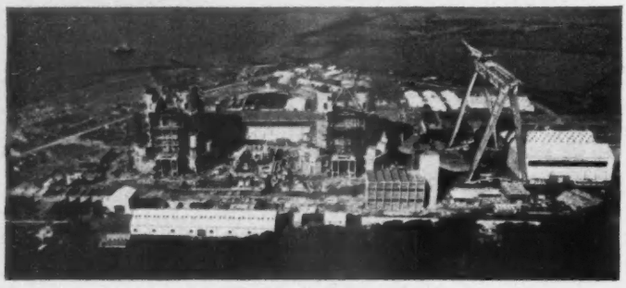


Fig. 3 (above) An aerial view of Hunterston nuclear generating station taken recently. The first steam raising unit of reactor A (left) can be seen on its plinth.

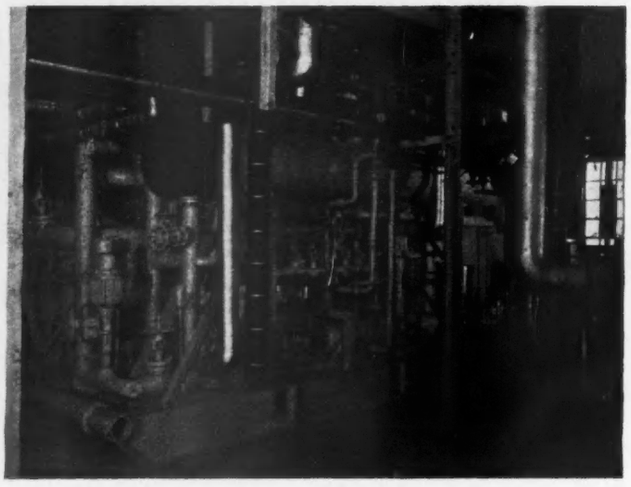


Fig. 4 (right) This skid assembly of the PM-2A for Greenland contains the feedwater package showing the post heat-exchanger, feedwater heater and storage tank, the primary make-up, blowdown, demineraliser and feedwater treatment components.

IAEA Activities

The wide scope of the International Atomic Energy Agency is illustrated by the director general in his report to the board of governors. Between May and August, 1960, a nuclear power survey in Finland had been made; the Netherlands Government had requested a hazards' evaluation of the high-flux reactor under construction at Petten; the agency had assisted in setting up an accounting and storage procedure for nuclear materials within the Seibersdorf Reactor Centre. The director general further reported that nine new research contracts had been awarded, and thirty member countries had requested technical assistance from the agency in the form of exports or equipment. Since the beginning of the Agency's fellowship programme in 1958, 995 students had been accepted by the Agency for studies abroad. Finally, the Agency's preliminary technical assistance mission had visited Greece, the Ivory Coast, the Federation of Mali, Morocco, the Sudan and Tunisia and reports were being presented.

At the coming fourth session of the Agency the proposed budget figures submitted to the conference for 1961 are: regular budget (from assessed contributions) $6,186,000 ($5,843,000) and operational budget (from voluntary contributions) $1,800,000 ($1,590,000). Figures in brackets are for 1960.

Hunterston Progress

Although a year behind the original schedule due to initial siting and labour troubles, the Hunterston nuclear power station is now progressing rapidly. The pressure vessel of reactor A is nearing completion and if the

Nuclear Submarines Galore

The Admiralty recently announced that a contract had been placed for a second nuclear powered submarine with Vickers-Armstrongs. The significant difference between the new submarine and the Dreadnought is that it will be entirely British from stem to stern. In its predecessor—the Dreadnought due to be launched on 21 October—the aft third including the reactor plant was American. It is hoped that the new submarine will be in service with the Fleet by 1964. The Dreadnought should be in service by 1962. Neither is designed for an offensive role and adaption for this purpose would require considerable re-designing. The design of the reactor is similar to the Dreadnought's but with some British modifications. Meanwhile in America a successor to Skipjack has been commissioned from the General Dynamics Corporation. It is named Scorpion. The reactor will be similar to Skipjack's, that is, of the pressurised-water design, and the main advance will be in the streamlined hull and the use of a single propeller. Finally, the United States' third Polaris missile-firing nuclear submarine—the Robert E. Lee—has successfully completed its sea trials. It will be able to carry 16 of the solid-fuel missiles which it can launch from the submerged position.

Reactor Notes

United States Aid to Pakistan: $350,000 has been granted by the USAEC to the Government of Pakistan toward the cost of a nuclear reactor project at the Pakistan Institute of Nuclear Science and Technology near Rawalpindi. The reactor is a 5 MW pooltype using solid fuel.

Critical Yankee: USAEC's 134 MW(e) pressurised water, uranium oxide fuel reactor reached criticality on 19 August. It is the first to be completed under the AEC's Power Demonstration Reactor Programme and will provide technical and economic data for the production of economic nuclear power. The reactor will operate at 2,000 lb per sq. in. the maximum water temperature will be 529° F. (276° C) with a flow of 94,800 gallons per minute. The control rods are made from silver, indium and cadmium alloys.

Parcelling a Reactor to Antarctica: The McMurdo Sound has been chosen as the site for the 1·5 MW(e) reactor named PM-3A to be built by the Martin Company for the AEC. The reactor is a pressurised water type, moderated and cooled with light water and should be in operation by early 1962. It will be assembled at the factory in packages and shipped to the site for erection. The construction will have to take place during the very short Antarctic summer season. Fig. 4. shows a skid assembly for the PM-2A in Greenland.

No. 5 at Chalk River: ZED-2 recently went into operation after the preliminary testing. This low-power reactor will be used for investigating the best method of arranging and building the uranium rods for Canada's future nuclear generating stations. The project cost $3,000,000 and construction began in spring 1959.

'Engineering' Appointments Section

Professional Engineers

and an

Assistant Design Engineer

required for the

CULHAM LABORATORY, ABINGDON, BERKS.

now under construction for the

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

to prepare specifications with drawings of laboratory and office buildings, and equipment and services required for thermonuclear research. Work involves liaison with scientific and technical staff to determine requirements, inspection of site construction and on the spot acceptance testing of installations.

Applicants should have served a recognised engineering apprenticeship or have had equivalent training and for the engineer posts should be Corporate members of a Senior Engineering Institution or have equivalent qualifications; for the Assistant Design Engineer post, H.N.C. and several years' drawing office experience required.

Experience of the following required:—

Design, installation and maintenance of recently installed HV and MV distribution networks, including control, instrumentation and protective gear, and power lighting, and heating installations, including ventilation equipment, water treatment plant, and compressed air and gas supplies.

SALARY: ENGINEERS: £860 (at age 25)-£1340 p.a. or £1370-£1825 according to experience.

ASSISTANT DESIGN ENGINEER: £930-£1340 p.a.

Housing and superannuation schemes.

Send POST CARD for details to PERSONNEL MANAGER (CAP/13/01/26), U.K.A.E.A., A.E.R.E., Harwell, Didcot, Berks.

D 54

AUSTRALIA

RYLANDS BROTHERS (Australia) PROPRIETARY LTD., NEWCASTLE, NEW SOUTH WALES.

This Company is the major subsidiary of Australian Wire Industries Pty. Ltd., and is inviting applications to fill the following positions.

DESIGN ENGINEERS
General design of wiredrawing and wire processing plant, equipment and buildings in a works producing 3000 tons per week of steel wire.
3 positions
Qualifications: Engineering degree or H.N.C.

DETAIL DRAUGHTSMEN
Detail draughting of wiredrawing and wire processing plant, equipment and buildings working under the supervision of qualified design engineers.
4 positions
Qualifications: O.N.C.

MARINE ENGINEER
To supervise plant maintenance of wiredrawing works and services, including steam generation with possible promotion to Foreman Mill Fitter in charge of 35 fitters and labourers.
1 position
Qualifications: O.N.C. with marine experience.

CONSTRUCTION ENGINEER ASSISTANT
General Supervision of plant construction work under direction of the Construction Engineer.
1 position
Qualifications: O.N.C.

SENIOR METALLURGISTS
General plant metallurgical investigation and control work on wiredrawing and wire processing of high and low carbon wires at a plant producing up to 3000 tons of steel wire per week. Responsible to Chief Metallurgist.
3 positions
Qualifications: Metallurgical degree or H.N.C. with L.I.M.

ASSISTANT METALLURGISTS
Generally assisting and directed by plant metallurgists on investigation and control work associated with the production and processing of ferrous wire high and low carbon at a plant producing up to 3000 tons of steel wire per week.
4 positions
Qualifications: O.N.C.

CHIEF CHEMIST
To take control of chemical laboratory on a steel wire plant and be responsible to the Technical Superintendent. Duties will include the introduction of latest instrumentation for analytical work and supervise the work of 6 or more junior chemists.
1 position
Qualifications: B.Sc. (Chemistry)

PHYSICIST
To organise investigation and control work associated with a steel wire plant reporting to the Technical Superintendent.
1 position
Qualifications: B.Sc. (Physics)

PRODUCTION ENGINEERS
To carry out job methods analyses and time studies on various production processes in a steel wire mill producing 3000 tons of wire per week.
2 positions
Qualifications: O.N.C.

Please address applications in writing to

BOX "A.R.B."
c/o J. W. VICKERS & CO. LTD.,
7, GREAT WINCHESTER STREET,
LONDON, E.C.2.

C 943

PUBLIC APPOINTMENTS

CENTRAL ELECTRICITY GENERATING BOARD
NORTH EASTERN AND YORKSHIRE REGION
THIRD ASSISTANT ENGINEER
EFFICIENCY AND TESTING SECTION

Applicants are invited for the position of THIRD ASSISTANT ENGINEER in the Efficiency and Testing Section of the Generation Operation Department, Yorkshire Divisional Headquarters, Leeds.

Applicants should be educated to at least Higher National Certificate standard in Mechanical Engineering and should have had experience of operation of modern power stations.

The successful applicant will be responsible for carrying out tests, investigations and efficiency studies on power station plant throughout the Division. He will be based at Skelton Grange Power Station but will be expected to travel in connection with his duties.

The salary for the appointment will be in accordance with the National Joint Board Agreement Grade 6 BX, Schedule B, £1285-£1610 per annum.

Forms of application may be obtained from the ASSISTANT REGIONAL SECRETARY (PERSONNEL), CENTRAL ELECTRICITY GENERATING BOARD, NORTH EASTERN AND YORKSHIRE REGION, 1, WHITEHALL ROAD, LEEDS, 1, to whom they should be returned to arrive not later than the 31st October, 1960. D 68

COUNTY OF LEICESTER
COALVILLE MINING AND TECHNICAL COLLEGE

Principal: W. A. BURROWS, B.Sc.

Applications are invited for the post of HEAD OF DEPARTMENT OF ENGINEERING AND BUILDING, GRADE II (Salary: £1600 by £50 to £1800).

Applicants should be University Graduates in Engineering and/or have equivalent professional qualifications with appropriate teaching and industrial experience. Further particulars may be obtained from the Principal on receipt of a stamped addressed envelope.

Applications (no forms) giving age, education, qualifications and teaching and administrative experience, together with copies of two recent testimonials and the names of three referees, should be sent to the PRINCIPAL, MINING AND TECHNICAL COLLEGE, BRIDGE ROAD, COALVILLE, by 7th October, 1960. D 40

MIDDLESEX COUNTY COUNCIL
EDUCATION COMMITTEE
BRUNEL COLLEGE OF TECHNOLOGY, WOODLANDS AVENUE ACTON, W.3

Principal: DR. J. TOPPING, M.Sc., D.I.C., F.Inst.P.

DEPARTMENT OF MECHANICAL ENGINEERING

Applications are invited for the following posts:—
(*a*) SENIOR LECTURER in Mechanical Engineering for advanced teaching in Fluid Mechanics and Heat Transfer or other senior and postgraduate engineering subjects.
(*b*) ASSISTANT GRADE B to teach Applied Mechanics and associated subjects.

Candidates should, preferably, have an honours degree and professional qualifications with teaching and industrial or research experience. Opportunities are given for research and continued contact with industry is encouraged.

The College is actively developing courses leading to the Diploma in Technology, Higher National Certificate and Higher National Diploma and arranges postgraduate short courses on specialist topics.

Salary will be within the range—Post (*a*) £1588 to £1801, Post (*b*) £828 to £1486 including London Allowance, at a point depending on age, qualifications and experience.

Further information and forms of application may be obtained from the Principal, to whom completed forms should be returned by 14th October, 1960.

C. E. GURR, M.Sc., Ph.D.,
CHIEF EDUCATION OFFICER. D 53

SOUTH AFRICAN COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH
NATIONAL INSTITUTE FOR ROAD RESEARCH
VACANCY:
CIVIL ENGINEER

Applications are invited from graduates in Civil Engineering, with several years practical experience of road construction and maintenance, for the post of Research Officer in the Soil Mechanics Division of the National Institute for Road Research, Pretoria, South Africa.

Research is to be done into the construction and maintenance of gravel roads with the object of reducing costs and alleviating the dust nuisance. The project is to be started by a thorough examination on full-scale road trials of the use of waste sulphite liquor from the pulp industry.

The salary will be according to qualifications and experience on one of the following scales:—
Senior Research Officer: £1380 by £60 to £1740 by £60 to £1860.
Research Officer: £1080 by £60 to £1320 by £60 to £1560.

The Council will bear the cost of transfer of the successful applicant and his family from place of residence to Pretoria and will contribute to the cost of transport of household effects. A certificate of good health and a chest X-ray examination will be required.

Information regarding general conditions of service may be obtained from the South African Scientific Liaison Officer, Africa House, Kingsway, London, W.C.2.

Formal applications for the post giving full details of age, marital status, nationality, scientific and technical qualifications and experience, and the names of at least two persons to whom reference may be made, should be submitted, in the first instance to the SOUTH AFRICAN SCIENTIFIC LIAISON OFFICER, LONDON. C 981

ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS

AIR MINISTRY require ASSISTANT MECHANICAL AND ELECTRICAL ENGINEERS for design, construction and maintenance of installations on airfields, radar stations, missile bases, workshops and maintenance units for R.A.F. at home and overseas as well as certain Civil Airports. Salary: £805 at 25 to £1095 at 34 or over, thereafter rising to max. £1260 with increase for London and slight decrease for country districts. Appointments non-pensionable but long term. Promotion prospects. Five-day week with 4 weeks 2 days leave a year initially. Special allowance in addition to salary during overseas service. Qualifications and experience:
(I) (*a*) University degree or equiv. diploma in electrical and/or mechanical engineering with at least 2 years' apprenticeship; or
(*b*) Graduate or corporate member of I.E.E. with at least 3 years' apprenticeship; or
(*c*) Graduate or corporate member of I.Mech.E. appreciable electrical engineering experience with at least 3 years' apprenticeship; and
(II) Have been employed for minimum of 2 years with well established engineering concern and gained wide experience in both electrical and mechanical engineering practice.

Applicants must be natural born British subjects between ages of 25 and 45.

Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D.158/OA. C 771

MINISTRY OF AVIATION

requires TECHNICIAN at Harefield, Middlesex, for the physical testing of metallic materials including determination of fatigue properties and the evaluation of elastic properties at widely different straining rates and at normal and elevated temperatures. Development of new techniques is an important feature of the duties. Qualifications: Recognised eng. apprenticeship. O.N.C., C. & G. Final Certs. or equiv. qual. in Metallurgy. Experience in mechanical testing is essential. Salary: £975-£1115.—Application forms from MANAGER (P.E. 2921), MINISTRY OF LABOUR, PROFESSIONAL AND EXECUTIVE REGISTER, ATLANTIC HOUSE, FARRINGDON STREET, LONDON, E.C.4. D 60

Palmer

AERO PRODUCTS LTD.

BTR INDUSTRIES LTD. AERO DIVISION

Owing to rapid expansion, in well-established and new fields, require in LONDON (near Edgware Road Station—excellent accessibility).

PROJECT ENGINEERS (Ref. P/PE)

Responsible for design of FILTRATION equipment for aircraft and other high performance applications or for design of pipe assemblies (P.T.F.E. rubber including COUPLINGS and fittings). Excellent opportunity for a man with initiative and experience in a company which already has a successful record of achievement in these fields.

Qualification: Engineering degree (A.M.I.Mech.E. or at least H.N.C.).

ASSISTANT PROJECT ENGINEERS (Ref. P/AP)

Minimum qualification—H.N.C.

To work on :—

1. AERO ENGINE applications for rigid and flexible HYDRAULIC and PNEUMATIC pipes also for electrical conduit installations.
2. FLUORO CARBONS—extrusion and fabrication of fluoro carbon for FLEXIBLE PIPE installations. This is a new field.
3. FLUORO CARBON LININGS—technical development of LININGS for industrial installations requiring complete RESISTANCE TO CORROSION; liaison with customer and production; setting of standards, design authority, etc. Candidates should have design experience of the layout of chemical plant, oil refinery pipework, etc.

The Company offers:—

HIGH SALARIES, commensurate with qualifications and experience.
EXCELLENT PROSPECTS of promotion.
EDUCATION AND TRAINING — positive encouragement with further studies.
GOOD PENSION AND BENEFIT SCHEMES.
HOLIDAYS—rising from 3 weeks after one year.

Send full details of experience, education, age, etc., including salary earned, with advertisement reference to

Mr. P. K. Brewin,
PALMER AERO PRODUCTS LTD.,
Herga House, Vincent Square, London, S.W.1 D 35

THE GOVERNMENT OF NORTHERN NIGERIA

requires a

SENIOR WATER ENGINEER

on favourable contract terms.

QUALIFICATIONS: A University Degree or Diploma recognised by the Institute of Civil Engineers and at least two years subsequent practical experience OR has passed Parts I and II of the Institution examination or obtained exemption and has had at least five years practical experience in all. In addition, candidates should have had at least ten years experience in design, construction and maintenance of urban water supplies. Administrative experience in urban water supplies will be an advantage.

DUTIES: To undertake and supervise preliminary investigations and design of water works and water supply projects.

EMOLUMENTS: 1. *Salary*, £2752.

2. *Outfit Allowance* of £45 and Touring Equipment Allowance of £40 on first appointment.

3. *Resettlement Grant* of £37 10s. 0d. for each three months' service inclusive of earned leave, payable on satisfactory completion of contract.

4. *Children's Allowance.* £120 for one child, £216 for two, £288 for three, payable on satisfactory completion of contract.

5. *First-Class Passages* for officer and wife on appointment and on leave, and assistance towards cost of children's passages.

LEAVE: Generous home leave on full pay.

Applicants should write to:—

THE RECRUITMENT SECRETARY (OVERSEAS),
NORTHERN REGION RECRUITING AGENCY,
NIGERIA HOUSE,
9 NORTHUMBERLAND AVENUE,
LONDON, W.C.2.

or telephone TRAfalgar 1244, Extension 145. D 30

FAIREY AVIATION LIMITED

Hayes, Middlesex.

VIBRATION TEST DEPARTMENT.

VIBRATION ENGINEER

required for senior post

to work on practical investigations of vibration and fatigue in helicopters.

Candidates should be graduates or hold H.N.C. with Endorsements and have several years experience in this field.

APPLICATIONS FOR THIS INTERESTING AND REWARDING POSITION SHOULD BE SENT TO THE PERSONNEL MANAGER AT HAYES, MIDDX.

D 14

WAR DEPARTMENT

requires ASST. ELECTRICAL ENGINEERING OFFICERS in R.E.M.E. Radar and Telecommunications Branches at Malvern Wores., and Christchurch, Hants., and in Command Workshops at Kinnegar, N. Ireland. Duties include liaison between agencies and R.E.M.E. on maintenance and repair of radar equipment during design and development; preparation of technical handbooks on communications basic techniques and equipment; supervision of group dealing with maintenance and repair of telecommunications equipment. Experience and quals.: Recognised engineering apprenticeship with subsequent experience on any of above duties, but with emphasis on repair and maintenance of radar or telecommunications equipment. Corporate membership of I.E.E. or equiv. Salary: £780 (age 25)-£1220 Provincial. £830 (age 25)-£1300 London. Excellent career prospects.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting D618/OA. Closing date 31st October, 1960. D 66

EAST AFRICAN RAILWAYS AND HARBOURS ADMINISTRATION

ASSISTANT MECHANICAL ENGINEER

Pensionable appointment. Salary £1170-£1755 (at present under revision). Free passages. Free furnished quarters for first tour; thereafter furniture rental is payable.

Candidates preferably 25-45 years must have passed or be exempt from Parts I and II of the examination of the Institution of Mechanical Engineers and have served an apprenticeship with a British railway or a firm of locomotive or diesel engine builders, followed by at least 4 years' practical experience in the Mechanical Department of such an undertaking.

Candidates may also be considered for contract appointment on special terms with gratuity.

Write DIRECTOR OF RECRUITMENT, COLONIAL OFFICE, LONDON, S.W.1, giving full names, age, qualifications and experience, quoting BCD 173/06/D5. D 65

UNIVERSITY OF BIRMINGHAM

DEPARTMENT OF CIVIL ENGINEERING

In connection with expansion of the Department, applications are invited for THREE LECTURESHIPS IN CIVIL ENGINEERING. Salary within the scale £1050 by £50 to £1400 by £75 yo £1550; £1550 by £75 to £1850, according to qualifications and experience. The appointments will date from a time as soon after 1st October, 1960, as possible and will carry F.S.S.U. and family allowance benefits.

Applicants should have one of the following:

(*a*) A specialised and extensive knowledge of structural theory and, in particular, of plastic design.

(*b*) A knowledge of structural theory and, in particular, of reinforced concrete construction.

(*c*) General Civil Engineering experience and a particular interest in Surveying and/or Public Health.

For each appointment a good honours degree in Engineering and some practical experience are required, and time and facilities would be available for research work.

Applications (3 copies), with the names of three referees, should be sent by 31st October, 1960, to the REGISTRAR, THE UNIVERSITY, EDGBASTON, BIRMINGHAM, 15, from whom further particulars may be obtained. D 45

CAMBRIDGESHIRE EDUCATION COMMITTEE

CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART

(PRINCIPAL: D. E. MUMFORD, M.A.)

LECTURER IN ELECTRICAL ENGINEERING required 1st January, 1961, for work with Higher National Certificate and Higher National Diploma Sandwich Courses.

Candidates must have graduate or equivalent professional qualifications, with appropriate experience in industry and teaching.

Salary: Burnham Scale for Lecturers in Establishments of Further Education, *i.e.*, £1370 by £35 (1 of £40) to £1550.

Further particulars and forms of application, to be returned by Monday, 10th October, may be obtained from the PRINCIPAL, CAMBRIDGESHIRE TECHNICAL COLLEGE AND SCHOOL OF ART, COLLIER ROAD, CAMBRIDGE. D 44

WESTERN REGION

of

BRITISH RAILWAYS

require:—

ENGINEERING ASSISTANTS (capable of supervising Drawing Office staff) and Technical Assistants experienced in the design of reinforced concrete and steel bridges and other structures to fill vacancies in posts in the salary ranges £1095/£1150 and £875/£948 respectively.

Interesting work in pleasant conditions with promotion on MERIT;
Superannuation Fund;
Reduced rates of travel and other concessions;
Five-day week.

Applications, giving age, qualifications and experience, to:—

CHIEF CIVIL ENGINEER,
BRITISH RAILWAYS,
WESTERN REGION,
PADDINGTON STATION,
LONDON, W.2.

D 33

STATION ENGINEERS (G.D. & MECH.)

AIR MINISTRY require STATION ENGINEERS (G.D.) and STATION ENGINEERS (MECH.) at R.A.F. and Ministry of Aviation Stations. The work of Station Engineers (G.D.) consists of installation, operation and maintenance of high and medium voltage electrical distribution systems, electrical power and lighting installations, control systems and generating plant: knowledge of heating and ventilating plant and diesel engines an advantage. Station Engineers (Mech.) are concerned with diesel power plant, steam and hot water heating systems, refrigeration and air conditioning and miscellaneous workshop plant, tools and equipment. Candidates must hold O.N.C. or Mech./City and Guilds Electrical Technician's Certificate/2nd Class M.O.T. Certificate or equivalent and must also have had recognised apprenticeship with firm of good repute plus 3 years' employment in electrical or mechanical and engineering, preferably on operation and maintenance of mine, factory or workshops plant and services. Preference to candidates with supervisory experience.

Commencing salary dependent upon age, qualifications and experience and ranges from £770 to £875 rising by annual increments to £925. Opportunities for promotion up to Tech. Grade A, maximum salary £1680 (National rates). Pension prospects. Five-day week. 18 days paid leave a year initially. Internal training courses provided and attendance at technical colleges by suitable candidates is sponsored. Overseas tours for which special allowances are payable in addition to higher salary. Applicants, who must be natural born British subjects, up to age 55, should write stating age, qualifications and experience to MANAGER (P.E.1), PROFESSIONAL AND EXECUTIVE REGISTER, MINISTRY OF LABOUR, ATLANTIC HOUSE, FARRINGDON STREET, E.C.4. No original testimonials should be sent. Only applicants selected for interview will be advised. G 892

THE SCIENTIFIC CIVIL SERVICE

needs men and women for pensionable posts as (*a*) EXPERIMENTAL OFFICERS and (*b*) ASSISTANT EXPERIMENTAL OFFICERS in Mathematics, Physics, Meteorology, Chemistry, Metallurgy, Biological Sciences, Engineering, Miscellaneous (Geology, Library and Technical Information Services). Candidates must, on 31.12.60, be at least 26 and normally under 31 for (*a*), and at least 18 and normally under 28 for (*b*). Qualifications should normally include H.S.C., or G.C.E., or equivalent, or H.N.C. or University degree. Provisional admission if taking examinations in 1960. Men's salary scale (London) (*a*) £1075-£1325; (*b*) £447 10s. (at 18) to £794 (26 or over) rising to £970. Promotion prospects. Further education facilities.—Write CIVIL SERVICE COMMISSION, 17, NORTH AUDLEY STREET, LONDON, W.1, for application form, quoting **S 94-95/60.** D 59

WARWICKSHIRE EDUCATION COMMITTEE

RUGBY COLLEGE OF ENGINEERING TECHNOLOGY

(Principal: G. S. ATKINSON, M.Sc., Ph.D.)

Expansion of Degree and Diploma in Technology Sandwich Courses has created vacancies for LECTURERS IN MECHANICAL ENGINEERING. New laboratories are being established, offering good facilities for research.

Applications are invited from graduates, with suitable industrial and academic backgrounds, who have an interest in teaching "Theory of Machines."

Salary (Burnham Scale) £1370 by £35 to £1550. In approved cases the starting salary may be above the minimum.

Further particulars and application forms from the Principal of the College, Eastlands, Rugby, to whom replies should be sent as soon as possible.

N. A. Y. YORKE-LODGE,
County Education Officer. D 56

BRITISH STANDARDS INSTITUTION

Appointment of

TECHNICAL OFFICERS

The B.S.I. invite applications from those with qualifications in engineering, chemistry or related science subjects to join the technical staff of the Institution. This staff is responsible for the work of the B.S.I. in the preparation of British Standards in co-operation with the various sections of industry and science, and for the presentation of the U.K. point of view in international discussions on standards. The technical staff plan and progress the work and act as secretaries to technical committees. For one of the appointments some experience in engineering metallurgy is desirable.

Applicants should have a university degree or equivalent professional qualification.

There are three grades of appointment, with an overall salary range up to £2000 plus; applications are invited for the grade which has at present a maximum salary of £1350, the starting salary being dependent on individual qualifications and experience. The posts are pensionable.

Apply to the ESTABLISHMENT OFFICER, BRITISH STANDARDS HOUSE, 2, PARK STREET, LONDON, W.1, quoting reference Tech. (G). D 69

INSTRUMENT MAKER

required by MINISTRY OF LABOUR for appointment as Instructor (Unestab.) at the Leicester Government Training Centre. Must be British subject, experienced, fully skilled, able to teach his trade and supervise the work and maintain control of trainees. Should preferably possess an O.N. or C. & G. cert. or equiv. quals. Will be required to pass a theoretical trade test before appointment and a practical test of normal trade skills after taking up appointment. Prospect of eventual establishment. Salary £955 (at age 30 or over) rising by annual increments to £1030 p.a.—Write for application form to: THE MANAGER, GOVERNMENT TRAINING CENTRE, HUMBERSTONE LANE, LEICESTER, within seven days. D 61

BRITISH STANDARDS INSTITUTION

HEMEL HEMPSTEAD CENTRE

An ENGINEER is required by the B.S.I. for inspection and testing work in connection with their testing station at Hemel Hempstead.

The work will be varied and will include inspection visits to the works of manufacturers operating under the Certification Mark scheme, the testing of samples selected on such visits, and the setting up of laboratories associated with Certification Mark schemes.

Applicants should preferably be graduates of the Institution of Mechanical Engineers or of the Institution of Electrical Engineers, and should have served an articled student apprenticeship.

The starting salary will be commensurate with qualifications and experience. The post is pensionable.

Apply to the ESTABLISHMENT OFFICER, B.S.I., 2, PARK STREET, LONDON, W.1, quoting Reference ENG. (H.H.). D 70

MIDDLESEX COUNTY COUNCIL

EDUCATION COMMITTEE

ENFIELD TECHNICAL COLLEGE,

QUEENSWAY, ENFIELD, MIDDX.

DEPARTMENT OF CIVIL AND MECHANICAL ENGINEERING

Principal: R. McCRAE, B.Sc. (Eng.), M.I.Mech.E.

Required for 1st January, 1961:

SENIOR LECTURER IN MECHANICAL ENGINEERING to teach Mechanics of Fluids to B.Sc. (Engineering) Degree standard and to take charge of the subject in the Department.

Candidates must be University Graduates in Engineering, be Corporate Members of The Institution of Mechanical Engineers or The Institution of Civil Engineers and have had teaching and industrial experience.

Salary within the range: £1588-£1801 per annum.

Application forms (foolscap s.a.e.) from the Principal, to whom completed forms should be returned within 14 days of the appearance of this advertisement.

C. E. GURR, M.Sc., Ph.D.,
CHIEF EDUCATION OFFICER. D 71

CITY OF LEICESTER EDUCATION COMMITTEE

LEICESTER COLLEGE OF TECHNOLOGY AND COMMERCE

PRINCIPLE: R. E. WOOD, M.SC., F.INST.P.

Applications are invited for the post of LECTURER IN PRODUCTION ENGINEERING. Candidates should be Graduates of a British University, with appropriate experience and able to teach Production Engineering subjects to a high level.

Salary: Burnham Scale, £1370 to £1550 per annum, with increments for approved experience.

Further particulars and forms of application may be obtained from the REGISTRAR, LEICESTER COLLEGE OF TECHNOLOGY AND COMMERCE. D 38

WAR DEPARTMENT

requires ASSISTANT MECHANICAL ENGINEERING OFFICERS IN R.E.M.E. London H.Q., Command H.Q. and Workshops. Locations in U.K. Duties include workshop planning, organisation and management; work study investigations and applications; M.T. repair and maintenance; process and production planning and time costing. Engineering apprenticeship with subsequent experience on any of the above. Corporate membership of the Institution of Mechanical Engineers or equivalent. £780 (age 25)-£1220 Provincial, £830 (age 25)-£1300 London. Excellent career prospects.—Forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, quoting C.730/OA. Closing date 31st October, 1960. D 67

SENIOR LECTURERS OR LECTURERS

ELECTRICAL ENGINEERING. SENIOR LECTURERS OR LECTURERS required by ROYAL MILITARY COLLEGE OF SCIENCE, SHRIVENHAM, BERKS. Teaching is at University level and involves lecturing and laboratory work for London External B.Sc. (Engineering). Extensive, well-equipped, laboratories. Research encouraged. Quals.: 1st or 2nd class Hons. degree and a thorough grounding in electrical engineering, experience in electrical power and machines, and/or electrical theory and measurements. Salary: Senior Lecturer £1250-£1540; Lecturer £690-£1144. Starting pay may be above minimum; credit for post-graduate experience and National Service. Superannuable with good prospects of permanency. Accommodation for single men, houses for married men.—Further particulars and forms from MINISTRY OF LABOUR, TECHNICAL AND SCIENTIFIC REGISTER (K), 26, KING STREET, LONDON, S.W.1, QUOTING D.627/OA. D 81

UNITED KINGDOM ATOMIC ENERGY AUTHORITY

ENGINEERING DIRECTORATE, PRODUCTION GROUP

FUEL ELEMENTS—SENIOR ENGINEERING POSTS

The Production Group has the responsibility for manufacturing a wide variety of fuel elements both for the reactors being built under the Nuclear Power Programme and also for the new reactor systems being developed for the future. This work is carried out in the new factory of the Springfields Works.

Two vacancies occur in the grade of Assistant Chief Engineer (Fuel Elements) within the Fuel Element Design Office of the Engineering Directorate. These posts will be initially at the Production Group Headquarters, Risley, Warrington, Lancs., until the summer of 1961, and thereafter at the Springfields Works, Preston, Lancs.

Duties

(Post A). To lead a team of Engineers and Draughtsmen engaged on the design of fuel elements for nuclear power stations. This team will be responsible for the magnesium canned, uranium metal fuel elements for the civil reactors, both in this country and overseas, as well as for the Authority's own reactors. The work will include the preparation of detailed manufacturing drawings and also specifications for the manufacture of components.

Close collaboration with the Consortia and the Development and Engineering Group will be necessary on design and development aspects. Similar contact will be maintained with the Production and Technical Departments of the Springfields Works to ensure manufacture to give the required reliability in service.

(Post B). To lead a small team of Engineers and Draughtsmen engaged on the design of advanced and experimental fuel elements.

The work will include fuel elements for the Advanced Gas Cooled Reactor, for research and testing reactors, and for other prototype reactors which may be constructed by the Authority or for which the Production Group may contract to supply fuel, e.g. marine reactors. The team will be required to keep in touch with developments on the wide variety of fuel elements projected in the nuclear power field, to investigate design features and to assess the manufacturing problems involved. The work will include the preparation of manufacturing drawings and specifications where required.

Close collaboration will be necessary with the Development and Engineering Group and also with the Production and Technical Departments of the Works.

Qualifications and Experience

Applicants must have served a recognised apprenticeship and be corporate members of a Senior Engineering Institution, or hold equivalent qualifications. They must have had considerable experience of design, preferably on reactors or on plant where elevated operating conditions lead to problems of performance and endurance. Experience of development work and a knowledge of manufacturing techniques employed in large scale production are desirable. Sound technical ability and judgment are essential requirements to deal with unusual problems.

Commencing salary will be assessed within the range

£2,400 to £2,900 a year.

Contributory Superannuation. Staff Housing Scheme.

Please write for application form quoting reference P.163R/J2, to **Staff Officer, Production Group Headquarters, Risley, Warrington, Lancashire.**

Closing date: 24th October, 1960. D 36

METALS **ICI** **DIVISION**

VACANCIES

for

TECHNICAL STAFF

in

DIVISION ENGINEERING DEPARTMENT

for interesting work on a wide range of plant for producing non-ferrous metals in sheet, strip, wire, and extruded form

TITANIUM ZIRCONIUM BERYLLIUM SPORTING AMMUNITION

MECHANICAL ENGINEER

for Materials Handling Section

The scope is considerable and the position affords an opportunity to work with a team of design engineers and with production personnel on materials handling schemes. The successful applicant will deal with all types of modern materials handling plant, and will be responsible for the selection of suitable equipment and supvervision of the design work involved. Age 28 to 36.

Qualifications—University degree or equivalent professional qualification in mechanical engineering with some knowledge of modern electrical equipment.

PLANNING ENGINEER

is required to assist design engineers in the planning and progressing of capital construction projects.

Duties will consist of the preparation and maintenance of working programmes, ordering of plant and materials, and the co-ordination of site work and installation.

Qualification—H.N.C. in mechanical engineering preferred.

DRAUGHTSMEN

with a good general engineering design background, or experience in any of the following—

Rolling mills and ancillaries.
Special purpose machines.
Industrial furnace equipment.
Materials handling equipment.

Qualification—H.N.C. in mechanical engineering preferred.

Good starting salaries, with prospects of progressive remuneration.
Appointments are pensionable.
Profit-sharing scheme in operation.
Removal expenses, lodging allowance, and assistance towards house purchase for married men.

Please write for an application form to the—

Assistant Personnel Manager (Staff),
IMPERIAL CHEMICAL INDUSTRIES LIMITED,
(Metals Division), P.O. Box 216
KYNOCH WORKS, WITTON, BIRMINGHAM, 6,

quoting Reference ENG/449/ENG. D 76

MSL *have been retained to advise on the appointment of a*

METHODS ENGINEER

for a manufacturing group employing large scale mixing, extrusion and heavy rolling processes and heavy mechanical handling equipment. This is a new appointment.

His duties will include the establishment of the most efficient and economic methods of handling work in progress, recommendations for changes of plant and methods, participation in planning the manufacture of new products and supervision of a time study office staff.

Candidates must be professional engineers, trained in work study, with several years' experience of methods of production engineering preferably in an industry employing continuous operations.

Preferred age 30 to 40 years. Initial salary £1,750 with pension and voluntary life insurance scheme. Please send brief details in confidence quoting reference F.2651 to P. A. Ashworth.

MANAGEMENT SELECTION LIMITED
212 West Regent Street, Glasgow, C.2.

In no circumstances will a candidate's identity be disclosed to our client unless he gives permission after a confidential interview at which he will be given full details of the appointment. D 62

AEI

MOTOR AND CONTROL GEAR DIVISION

DRAUGHTSMEN

Several Draughtsmen are required at our HUYTON (Liverpool) office for the Design of Electrical Control Gear. Previous experience in this class of work preferred but not essential. Qualified Draughtsmen on either Electrical, or light Mechanical work are invited to apply.

Several Electrical Draughtsmen are also required for the preparation of Wiring Diagrams. Positions are permanent, and the work offers excellent opportunities. These are staff positions qualifying for the Company's Pension Scheme. Full canteen facilities available. Five-day week finishing 4.30 p.m. on Fridays. Interviews will be arranged at Huyton.

Please write for application form quoting Reference S.16 to:—

Personnel Manager,

Associated Electrical Industries (Manchester) Ltd.,

Trafford Park, Manchester, 17.

C 990

ENGLISH ELECTRIC

has a limited number of vacancies for

COMMISSIONING ENGINEERS

for

NUCLEAR POWER STATIONS

and invites enquiries from engineers with experience of the operation of conventional plant for the above appointments. Successful candidates, who should be either associate members of a major professional institution or hold qualifications leading to associate membership, will hold responsible posts in a team engaged in the Commissioning and early operation of Nuclear Power Stations. Full training in the operation of Nuclear Power Stations will be arranged for the successful candidates.

Personal details, which will be dealt with in confidence, should be addressed to the TECHNICAL STAFF OFFICER, G.P.S., ENGLISH ELECTRIC HOUSE, STRAND, LONDON, W.C.2, quoting reference ENG 1888F. D 63

Another Opportunity in Iron and Steel

BISRA

Young Research Assistants are required for **MECHANICAL ENGINEERING** work of a varied and interesting nature, at the Association's Engineering laboratories in London (Battersea). Short visits to Iron and Steel Works may be expected in the course of the work. An Ordinary National Certificate, or better, in Mechanical Engineering is essential. Some workshop experience would be an advantage. Time off for study for further qualifications will be allowed.

Starting salary up to £825 per annum according to age, qualifications and experience. Five-day week. Canteen. Staff pension scheme.

Written applications only quoting M.E.16 to the PERSONNEL OFFICER, THE BRITISH IRON AND STEEL RESEARCH ASSOCIATION, 11, PARK LANE, LONDON, W.1. D 37

A small but progressive firm in a pleasant country area requires a **FOREMAN** to work with the Plant Engineer on maintenance of:—

Boilers
Evaporators
Kilns
Air Conditioners
Elevators
Conveyors, etc.

If YOU are a trained fitter and turner with experience in taking charge of men engaged on plant maintenance, we should like to consider you for this position.

If you are conscientious, energetic and enjoy hard work, age about 30-35, apply in writing giving full particulars about yourself to us. Salary—if you are the right man—a good one . . .
Munton & Fison Ltd., Stowmarket, Suffolk.

D 42

APPOINTMENTS OPEN

ASSISTANT MECHANICAL ENGINEER

required for design and development work on cable-making machinery. Some electrical experience is desirable. Applicant should have had practical experience as well as theoretical training at least up to H.N.C. standard. He must be capable of following his designs through manufacture and subsequent application. The work is interesting and progressive and offers scope to an inventive mind. Age 25-40.—Salary commensurate with ability and qualifications.—Apply in confidence to PERSONNEL OFFICER, SOUTHERN UNITED TELEPHONE CABLES, LTD., DAGENHAM, ESSEX. D 58

SENIOR ELECTRICAL DRAUGHTSMAN

required for interesting work on large chemical plant installations. Applicants should have some works experience in heavy industry and technical ability to deal with a large variety of problems. Duties include the preparation of power and lighting schemes. The position is permanent and an attractive salary will be offered to the selected applicant. Modern offices situated in the London E.C.4 area. Five-day week and superannuation scheme. Applications will be treated in the strictest confidence.—Replies, giving details of age, qualifications and experience and quoting ref LCL/E1/69 should be addressed to The Group Personnel Manager, LAPORTE INDUSTRIES LIMITED, Hanover House, 14, Hanover Square, London, W.1.

D 55

ENGINEERING SUPERINTENDENT

having requisite qualifications for corporate membership of one of the three senior institutions and preferably a degree, required for operation and maintenance of mechanical and electrical generating plant and installations, including diesel engines, deep well pumps, lighting, lifts and telecommunications, mainly in the City of London but also at a few premises in the Provinces. Age 45-50. Salary, £2500 p.a., rising £50 annually to £3000. Good non-contributory pension. Requests for application form to be made in writing to BOX D 32, Offices of ENGINEERING.

ENGINEER SURVEYOR

A leading Insurance Company has vacancies in the OXFORD, SOUTH BUCKS., and EAST BERKS. areas for ENGINEER SURVEYORS for the inspection of Boiler and Pressure Plant. Applicants, not over 38 years, must have 1st Class M.O.T. Certificate with Steam Endorsement or equivalent qualifications. Salary according to E.S.A. Scale starting at £800 p.a. Non-contributory pension and other benefits.—APPLY ENG. DEPT., GENERAL ACCIDENT ASSCE. CORP., LTD., 99, ALDWYCH, W.C.2. D 80

ENGINEERS

ENGINEERS wanted for inspection and reporting on lifting tackle. Essential to have served Engineering apprenticeship. Drawing office experience desirable. National Certificate of Mechanical Engineering an advantage. Must have knowledge of manufacture and maintenance of lifting tackle. South Essex area. Starting salary £800 with annual increments. Reasonable travelling expenses allowed. —Write BOX EG 864, L.P.E., ROMANO HOUSE, 399/401, STRAND, LONDON, W.C.2. D 79

THE DISTILLERS COMPANY LIMITED

SENIOR MECHANICAL DRAUGHTSMAN

The Company has a vacancy in its biochemical factory at Liverpool for a Senior Mechanical Draughtsman. Candidates, in the age range 25/40, should preferably have obtained the Higher National Certificate in Mechanical Engineering. They must have undergone a full workshop apprenticeship, and have experience in the design and lay-out of chemical plant. Duties cover process flow sheets, equipment lay-out, low pressure vessel design, pipework arrangements, small steel structures and similar work. The Company operates a non-contributory pension scheme and other fringe benefits.

Write:

STAFF MANAGER,
THE DISTILLERS COMPANY LIMITED
21/22 BOLTON STREET
LONDON, W.1.

Quote Ref.: 104/60E.

D 43

ENGINEER

for Inspection of Cranes and Lifting Plant required. Must have drawing office experience of design of Cranes also National Certificate in Mechanical Engineering. Areas Essex and Liverpool. Starting salary: £800 rising to £1100—other benefits—permanent.
Write BOX No. EN858, L.P.E., ROMANO HOUSE, 399/401, STRAND, LONDON, W.C.2. D 64

SENIOR ENGINEER

Wanted by Paper Mill near Dublin, SENIOR ENGINEER, with at least 20 years' experience of maintenance of heavy plant and installation of new plant on an extensive scale. University Graduate or Member of Institution of Mechanical Engineering preferred. Good salary offered to proved competent hard worker. Apply to BOX C957, Offices of ENGINEERING.

THE GLACIER METAL COMPANY LTD.

INVITES APPLICATIONS FROM

YOUNG PRODUCTION ENGINEERS

for a position in their London Service Station, a specialised production unit engaged in the manufacture, metalling and repair of plain bearings.

The Production Engineer is directly responsible to the Station Manager for ensuring that high production standards are maintained: for continuous investigation leading to methods improvement: for development of proposals for change in technical policy and for the practical implementation of these changes.

Candidates should have experience of machine shop medium engineering and preferably a good engineering qualification; knowledge of tool design, estimating, material handling and work study will be useful.

A man is sought combining strong technical qualifications with management potential since the post presents opportunities both for an immediate impact on production efficiency and subsequent promotion to a senior position.

Starting Salary up to £1350 p.a.

APPLICATIONS TO
PERSONNEL DIVISIONAL MANAGER
(REF. S.P.E.),
GLACIER METAL COMPANY LIMITED,
EALING ROAD, ALPERTON,
WEMBLEY, MIDDX. D 73

COMPANY MEETING

POWELL DUFFRYN LIMITED

The Annual General Meeting of Powell Duffryn Limited was held on September 21st in London, Sir Henry Wilson Smith, K.C.B., K.B.E. (the Chairman), presiding.

The following is an extract from his circulated statement:

I feel that the results of the year 1959/60 are not unsatisfactory. To me, and I hope to you, the most vital figure by which to test our strength and future is the Group's Trading Profit, after depreciation but before tax. For the previous two years, primarily because our new and growing activities were not yet able to take the strain of the substantial unavoidable fall in earnings from the Group's coal and shipping business, I had to report to you successive falls of £204,000 and £318,000 in total a reduction of over 25 per cent from the figure of £2,036,000 which had been attained in 1956/57. Now, and again in the face of further reductions in traditional, and especially coal, profits, I am glad to have a better story to tell. The increase of £354,000 in Trading Profits is, I believe a significant turning point, especially if we can look forward to an improvement in our shipping earnings and at least some degree of stabilisation in our coal business. As regards shipping, much will depend upon an early solution to the current labour troubles in the industry.

DIVERSIFIED RANGE OF ACTIVITIES

Diversification is regarded as a modern term, whether of abuse or of praise. The first point to realise in relation to the Powell Duffryn Group as now constituted is that for many years before the Second World War its individual Companies were engaged in a very diversified range of activities—**coal** (production, distribution, export, international trading, overseas companies and depots), **oil** (especially the first development of storage and bunkering), **shipping** (as owners and managers essentially coastal in character but also as shipping agents and brokers for overseas as well as home business), **engineering** (mainly at the heavy end of the industry, particularly in relation to the needs of collieries and railways), **timber business** (at home and abroad). The second point I would make is that, whilst the central core was eliminated when the Group's collieries and colliery investments were expropriated under the Coal Nationalisation Act, much remained as a base on which a new future could be built. An important step was the reorganisation of the capital structure in 1954/55 when payments in excess of £11 million were made to the Powell Duffryn shareholders, primarily by way of return of capital. In the result, Powell Duffryn is neither some kind of investment trust nor a so-called industrial holding company but the parent of a broadly based Group of industrial and commercial companies, with central control of policy combined with decentralisation of operation, much inter-weaving of management from the parent Board downwards, and a great deal of common interest based on our history but adapted to modern conditions.

A year ago, in the final paragraph of my Statement, I said "The development and expansion of activities which are appropriate both to us as a Group and to the unfolding pattern of industrial and commercial progress remains the main plank of your Board's policy and is well within our compass." That statement still stands.

ENGINEERING

A year ago I reported that **Powell Duffryn Engineering** had obtained the sole manufacturing rights in the United Kingdom for the mobile materials handling equipment of Dempster Brothers of the United States—*i.e.*, for the collection and transportation of scrap, waste and refuse. After much hard work, manufacture has begun, the necessary sales literature has been produced and the key salesmen have been appointed. Only a small volume of business was completed in 1959/60, but the prospects look encouraging.

A further item of interest is the recent award to the Company of a contract involving the establishment of a site workshop at the Spencer Works of Richard Thomas & Baldwins Limited.

The Report and Accounts were adopted.

D 31

Companies

The Future in Capital Goods

WHATEVER the outlook for capital equipment predicted by the Board of Trade, the HORSELEY BRIDGE & THOMAS PIGGOTT Company, who are closely concerned with capital equipment manufacture, are finding the recovery from last year's discouraging conditions to be on the slow side.

For some time ahead the capacity in conventional structural steelwork and platework products is expected to be greater than the demand. For this reason the Horseley Bridge company is pursuing a policy of diversification for all the companies in the group.

The tendency of the past two years for firms to cut their prices to the bone in order to keep up the volume of work, even at uneconomic prices, is expected to continue. But some slight improvement has been detected and some buyers of capital equipment are beginning to resume ordering, although on a modest scale.

On exports, the Horseley chairman, Mr. John V. Sheffield, asserts that exhortations alone will never provide the enthusiasm and drive for foreign trade essential to success. Since various forms of tax relief and benefits have been given by the authorities of our principal competitors, conditions where it pays to export should be brought about by the United Kingdom Government.

Something more sophisticated than a blanket thrown over home demand, such as the more flexible supply of export credits and taxation reliefs, is what Mr. Sheffield has in mind. Equally there is a need to improve the commercial side of the foreign service.

The representatives of some other countries do far more than is thought necessary by British overseas staff. Instead of commerce being in the forefront of our embassy activities it is still thought by too many to be "non-U."

Vickers at the Half Way Mark

Reporting on the first half of the year, the directors of VICKERS Limited are able to show sales (without sales inside the group) worth £75·67 million, compared with £73·03 million in the first half of last year.

The sales rate for the first half of the year is not running as fast as the annual figure for 1959, which reached £155·54 million. The group profit before tax for the first six months, £6·17 million, is better than the £5·17 million of the equivalent period in 1959.

Again the rate is not up to that of last year, whose final before-tax profit was £14·05 million, but the pace of trade picked up notably towards the end of the year.

With the more favourable tax position there is a healthier look about the after-tax figures. For the first six months of this year the profit after tax was £2·49 million, against £1·78 million. The after-tax profit for the group over the whole of last year was £4·93 million. Stock and work in progress, less instalments on contracts, are now worth £43·62 million, against £38·3 million twelve months ago.

Profits are estimated to be about as good now as in the first half of the year.

Solid Progress in Machine Tool Firm

A substantial increase in the activities of its member companies, sustained both at home and abroad, is reported by the directors of the TAP AND DIE CORPORATION in their annual report.

The period covered by the review covers the purchase of the INTERNATIONAL TWIST DRILL Company, of Sheffield, and the JOHN HARRIS TOOLS Company, of Warwick and Lichfield.

Due to this expansion the corporation's profits cover a period of 17 months. Before tax, the profits of the group were £820,814, which *pro rata* over a year would equal £709,300. The Tap and Die profits in the previous year were £314,691.

The International Twist Drill company included two subsidiaries, the PICKFORD TOOL Company and the VANADIUM STEEL Company.

The most notable effect of a comparison between the profits of the corporation and the trading level of the machine tool industry over the past ten years is the steady appreciation of Tap and Die profits from 1955 to 1957 at a time when machine tool trading was falling swiftly. Activity in machine tools has recovered and during this year has been rising rapidly. The profits of the corporation during the same period have much more than doubled.

John Laing Interests in South Africa Contracting

The complex and difficult industrial story of South Africa moves on another step with the recent decision of the JOHN LAING civil engineering organisation to reduce the scope of its Johannesburg company.

Set up in 1947, JOHN LAING AND SON S. A. Pty. has handled some very big contracts including office blocks, mining jobs, factories and road work. But now, between cut-throat competition and the flight of capital from the Union, the position has been reached where it may be said that too many companies are chasing too few contracts.

The Johannesburg office will be retained in order to take advantage of big contracts for which the company's tenders may be successful. But small contracts will not be tendered for and as works are finished heavier equipment is being sold. Plant needed for future big contracts will be bought as required.

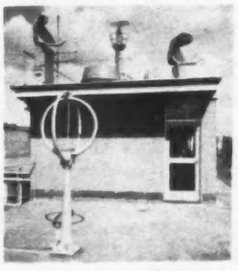
With the reductions at Johannesburg the main emphasis of the John Laing effort in Africa swings up North to Salisbury, Southern Rhodesia, where the company set up a year after going into the Union. Earlier this year Mr. J. M. Laing, the managing director, toured for 7,000 miles in Africa, seeing the conditions for himself and considering the future prospects.

Among the contracts that the South African subsidiary has carried out have been mining work for the ANGLO-AMERICAN CORPORATION, an eight storey office block for £800,000 for the Office of Public Works, municipal work in Johannesburg and the nationally known Voortrekker monument in Pretoria.

Functional Top for Marconi House in Hull

Storage of the heavier parts available at a service depot on its ground floor and of its lighter components on the higher floors may seem the proper way to do it. But not at the new Marconi service depot opened earlier this month in Hull.

The MARCONI INTERNATIONAL MARINE COMMUNICATION Company, having moved from its old building, now has a tower carrying a radar scanner



perched on top (inset) of the new Marconi House. Rather lower on the roof are three more scanners, each part of a distinct radar installation.

Lighter parts from the service depot are stored on the ground floor. It has been found that the smaller pieces are very much more frequently required and it pays to keep them handy. The first floor storage space carries the heavier equipment—complete transmitters, direction finding loops, radar scanners and motor-alternators.

From Tramways to Beyond the Brabazon

Aircraft, apart from being used as weapons, are a means of transport. This simple fact should soften the impact of discovering that the great BRISTOL AEROPLANE Company began in the mind of a Victorian bankruptcy expert, Parliamentary lawyer and take-over tycoon with tram interests—Sir George White.

The business-like approach of the founder is clearly set out in a new company history, *Bristol Fashion*, written by the author and poet John Pudney, an account of some early days in Bristol aviation, published by Putnam in a private edition.

There is a rising standard of books dealing with industrial history and John Pudney, who has all the added advantage of the romantic appeal of aircraft, has combined the personal involvement of the early engineers and members of the Royal Flying Corps, with some indication of the original engineering problems that had to be solved all the way along the line from the Bristol Boxkite to the Second World War Blenheim.

In those early years of Bristol, when aircraft like the Brabazon and the current Bristol all-steel research aircraft, the T 188, were the stuff of visionaries' dreams, there emerged figures on the heroic scale, like designer Frank Barnwell, whose work spanned the revolutionary Bristol F2B and the Blenheim bomber. Barnwell had a constant interest in the small do-it-yourself aircraft for the private flyer. An erratic pilot, it was his own BSW I that spun him to his death at the time of Munich, just as the need for his designing genius was about to become most acute.

Pudney's book makes it plain, while recording how the company came to be founded at the terminus of a tramway system, that if policy over which the company has no control permits, the Bristol will play its part in space aviation as it did in providing some of the first fighting aircraft.

Recovery Plans For German Car Firm

For the last ten years the one failure in Germany's booming car industry has been BMW, of Munich. This firm, one of the oldest and most famous in the industry, never recovered from the loss of its East German factories. Various plans were announced for its revival. At the end of last year it looked as though there would be a merger with Daimler-Benz.

This fell through. American, Swedish and British companies (notably Rootes) were at one time or another reported to be showing a cautious interest in BMW.

Now a solution has at last been arrived at which keeps control in German hands. MAN, the big engineering group, has agreed to buy 50 per cent of BMW-TRIEBWERKBAU, the jet-engine manufacturing subsidiary of BMW, and to lend the parent company DM 20 million with a ten year repayment period.

MAN is already in the jet engine business through its subsidiary MAN TURBO MOTOREN Company. One result of strengthening BMW's financial position is that the company now has a defence contract from the Federal Government. This is for the manufacture under licence of General Electric J79 jet engines for the lockheed F104 Starfighter. The order is said to be worth between DM 500 and DM 700 million.

The jet subsidiaries of MAN and BMW will coordinate their investment and production policies. Another result of the merger will be that BMW may share in the joint development agreement between MAN and Rolls-Royce for a light high performance jet engine for use in vertical take-off aircraft.

In the past BMW's fame rested on big luxury class cars, and motor cycles. The sales of the latter dropped from around 28,000 in 1952 to 7,000 last year. On the car front BMW introduced a new small car, the BMW 700 last year which has sold very well. Output is now at the rate of 200 a day and the firm reports more orders than it can cope with at the moment. Preparations are now being made to turn out a sports version of the BMW 700. This will have a more powerful engine and sell for about £35 more than the standard model. The company also has in an advanced state of design a promising 1·6 litre car.

The prospects are that extra capital will be needed to develop this model and presumably part of the MAN loan will be used for this purpose. It is likely to be two or three years before the 1·6 litre model comes into production.

Tributaries Converge to Make Soft Drinks

Basic to the production process is a sequence of operations. Planning a factory involves linking such sequences in a coherent pattern so as to feed their several contributions into the product.

THE basic operations in making any product may be combined in an infinite variety of ways. The task of the factory planner is to arrange these stages in a logical sequence, making the optimum use of space available. A clear-cut problem in factory planning is provided by the continuous preparation and bottling of soft drinks. One solution is embodied in the new Dublin factory of Batchelors Limited, which has been designed in collaboration with an architect by Vickers-Armstrongs (Engineers) Limited. Vickers were also main contractors.

The sequence of operations is indicated in Fig. 1. The sketch does not represent the actual layout in the factory but merely the flow pattern,

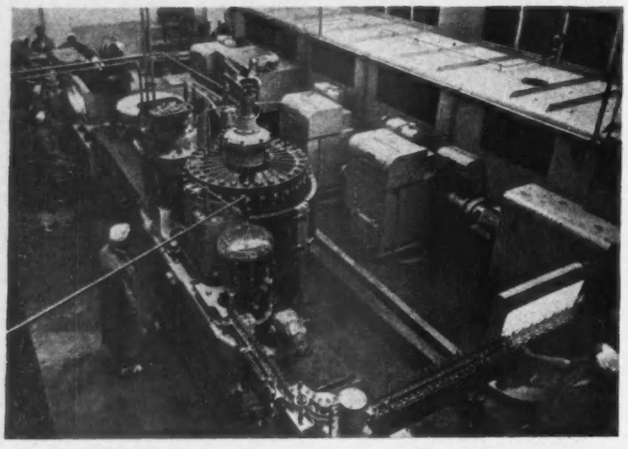


Fig. 2 (below) View of bottling plant, showing bottle washer in background and, in sequence: inspection, syrup injector, filler, crowner, mixer, inspection and labeller.

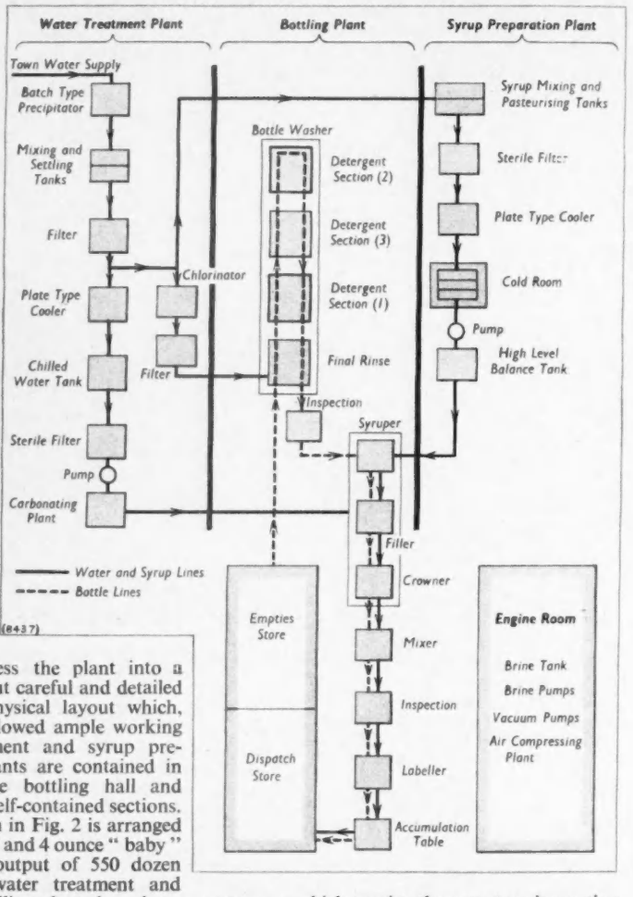


Fig. 1 (right) Flow lines for soft-drink plant.

and may be regarded as ENGINEERING's solution to the problem, with the requirements of physical convenience replaced by those of exposition. Although the conditions to be satisfied in preparing an explanatory drawing are far less formidable than the physical limitations imposed on the factory planner they may serve to illustrate the difficulties. Thus the sketch is intended to meet the following conditions: it should be consistent with the maker's written description—the operations being in the right order, the three main processes being shown in separate areas, the empties and dispatch stores occupying the same building and the engine room being adjacent to the bottling plant —and, in addition, for clarity, the main sequences should be shown as straight discrete lines, the lengths of pipelines and conveyors should be kept to a minimum, no liquid mains should cross, and the various stations should be indicated as separate entities where in reality several may sometimes be combined in a single unit. In reality the plant may be distributed among several floors, and a single flow line be folded round a room. The bottle washer is presumed to be of out-and-return pattern.

Following their entry into the field of bottling some years ago, when they undertook the bottling and distribution of Carlsberg Lager, Batchelors Limited decided to expand their activities in this direction by entering the soft drinks field. As a consequence of this decision negotiations were concluded with the Canada Dry Corporation to bottle and distribute their range of beverages, upon which Batchelors Limited invited a number of companies to submit proposals for a complete automatic bottling plant. After consideration, the Worssam Products division of Vickers-Armstrongs (Engineers) Limited were invited to carry out all the engineering work, and Mr. S. James Hurd was engaged as architect.

It was desirable that the plant be situated in close proximity to the company's existing lager bottling plant to centralise storage and loading facilities. Consequently, part of the building previously used for lager case storage was allocated for the new plant and a new extension was planned to provide for the storage of fulls and empties for both bottling operations. It was necessary to compress the plant into a relatively restricted area, but careful and detailed planning resulted in a physical layout which, although very compact, allowed ample working space. The water treatment and syrup preparation and handling plants are contained in separate rooms within the bottling hall and are themselves completely self-contained sections.

The bottling plant shown in Fig. 2 is arranged to handle 6½ ounce " split " and 4 ounce " baby " crown-top bottles at an output of 550 dozen bottles per hour. The water treatment and syrup preparation and handling plants have been installed to suit this output.

Water for bottling and syrup making purposes is drawn from the town supply and is treated on the premises by means of a batch-type precipitator plant. After treatment, water for syrup making is further filtered and passes directly to the syrup mixing tanks as required. For bottling the treated water is further filtered and is then chilled and stored in an insulated holding tank from which it passes through a final sterile filter to the carbonator.

The soft drink syrups are prepared, mixed and pasteurised in stainless-steel steam jacketted tanks equipped with agitators. After pasteurisation the syrup undergoes sterile filtration before cooling and is then transferred to an insulated cold room, where it is held in stainless-steel vessels. The cold-room temperature is automatically maintained at approximately 45° to 48° F by means of a small refrigerating plant. From the storage vessels the syrup is delivered by an automatically controlled pump, to a high-level insulated balance tank feeding the syruper.

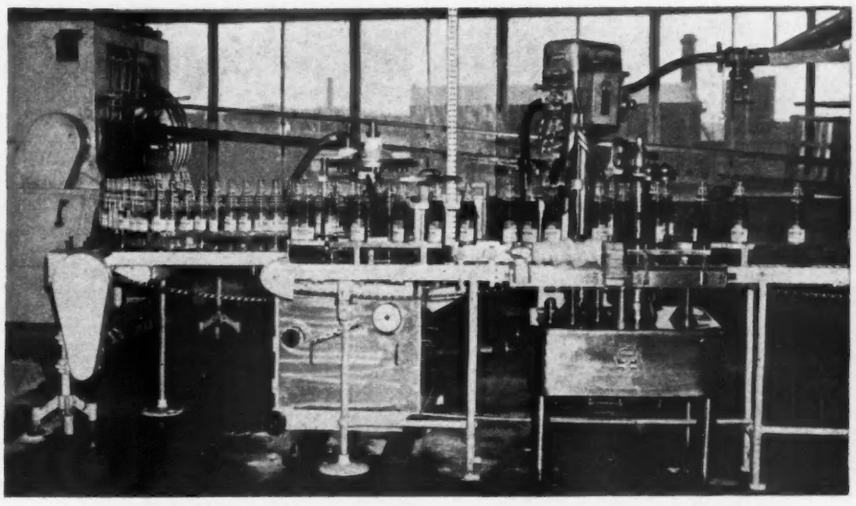
The bottling plant is of modern automatic design. Throughout the plant attention has been given to the maintenance of hygiene and sterility. In particular, the washer is arranged with three detergent sections and uses chlorinated and filtered water for the final rinse. All the compressed air used on the plant is subjected to sterile filtration by a Worssam sheet filter.

Cases of dirty bottles pass into the bottling hall from the adjacent empties store by means of a gravity roller conveyor and the bottles are placed by hand into the semi-automatic feed board of the washer. After washing, the clean bottles are automatically discharged on to a slat conveyor, which carries them past an inspection station to the filling unit.

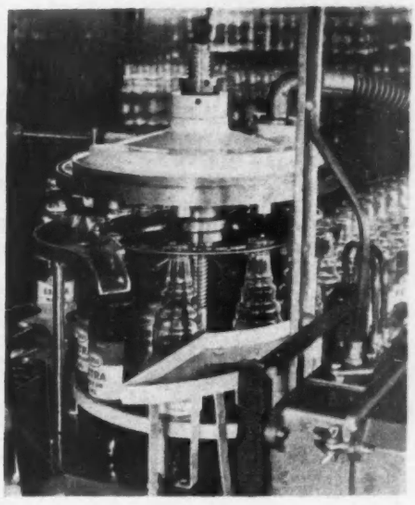
Each bottle passes first to the syruper where it receives a precise dose of syrup and thence to the filler where it is filled with carbonated water to an accurately controlled level. After filling, the bottle is automatically transferred to the crowner which applies the crown cork and then returns it to the slat conveyor. The bottles pass on to an automatic rotary beverage mixer.

After the mixer, and a second inspection station, the bottles are conveyed to the labeller which automatically applies both body and neck labels simultaneously. The bottles are discharged on to an accumulating table from which they are packed by hand into their cases. The full cases are then carried to the store by a case-conveying system incorporating a gravity roller conveyor operating with a light belt bumper.

Water chilling and syrup cooling is accomplished by means of Paraflow-type heat exchangers using brine at 22° F. Brine is supplied from an existing tank but new pumping and circulating equipment was installed to serve the new plant.



The new plant showing, from left to right, the washer, the filler and the sealer.



The Mather and Platt rotary pump filler.

Bottling Lubricants of Many Grades

An installation for the bottling of lubricating oil was recently completed at the Mode Wheel Terminal of the Esso Petroleum Company Limited which distributes to the Midlands and the North of England. The installation incorporates equipment which fills and caps pint and quart size bottles with lubricating oil varying in grade from SAE 10 to SAE 140. The bottles are filled at a rate of one a second. The plant also cleans empty bottles.

The first stage in the operation of the plant is to liquefy the oil residues in the bottles with hot air at 130 to 150° F. The oil residues then drain away easily. Streams of hot water at 145° F are then injected into the bottles which are drained for approximately one minute and passed into a detergent wash section for prolonged internal and external jetting treatment. After further washing, rinsing and drying, the bottles are discharged on to a conveyor leading to the filling and capping machines. The crates at present also pass through the washing machine on a conveyor alongside the bottles and receive the same thorough treatment. The washer was supplied by Dawson Brothers of Leeds.

The next stage, that of filling, utilises one of Mather and Platt's rotary pump fillers. These were formerly developed for use on foodstuffs and now exist in a modified form for many inedible products. They produce an accurate fill and are drip-free in operation. Their ability to work with a wide range of fills and container sizes is essential for this particular operation.

The filler operates on the basis of a timed fill at a constant rate of flow. The pump is a positive displacement (gear) type unit delivering consistent volumes at a given speed. The accuracy of fill is ensured by a PIV gear incorporating a positive non-slip belt.

After filling, the bottles pass to a rotary sealer fitted with a tab cap press, both from Fords (Finsbury) Limited. The rotary sealer makes, applies and seals a paper laminated aluminium foil tab cap. The tab cap comprises an 0·1 mm aluminium foil laminated to 0·06 mm 80 gm GIP paper.

Both filler and capping machine are driven by a single motor controlled by an Allen West starter. The starter incorporates safety devices connected to both machines so that they are stopped simultaneously if the occasion arises.

The discharge conveyor is 22 ft long and 4 in wide and is of the stainless steel slat chain type, powered by a ½ h.p. geared motor.

It is reported that the new plant has reduced the amount of floor space required, increased the potential capacity of the filling station by 100 per cent and the number of operatives has been reduced from 8 to 3, two of whom pack the bottles into the crates. This latter manual operation is made necessary because of the construction of the crate used.

The plant was laid out after consultation between Esso, Dawsons, Fords and Mather and Platt. They worked to a drawing of the complete installation supplied by Mather and Platt.

Complete Cold Forging Plant in One Line

A complete cold forging installation, claimed to be the first of its kind in the world, has been developed by a British company after extensive research and field trials. It takes the form of a production line that is capable of accepting raw bar stock at one end and ejecting the finished article at the other end. The installation was shown publicly for the first time in operation at the Hanover Machine Tool Exhibition.

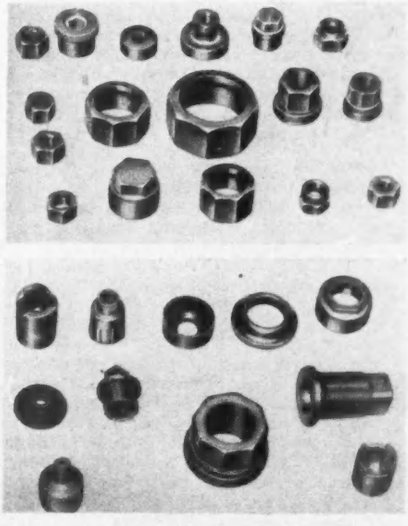
The equipment shown at Hanover is being manufactured by two companies, one in the UK and the other in Germany: both members of the Camp Bird Group. Altogether seven machines of their range will be shown. The essential basic units required for a complete cold forging system are a cropping machine, a preforming unit, a combined deburring and chamfering machine, a complete automatic cycle surface treatment plant and the cold forging machine itself.

Cold forging processes make controlled use of the plastic flow properties of metals in a complex shaping process. This not only requires machines of high rigidity, but also tools designed to withstand the considerable forces of cold forging in continuous operation.

Although it is more than unlikely that this process should displace chip-forming machining methods, there is a wide range of components in general demand which can be mass produced by cold forging at costs which are substantially lower than those of conventional systems. This is due partly to a saving of material: a 50 per cent saving is not exceptional and stands in marked contrast to chip-forming methods. It is also due to the high production rates obtainable and to a lesser extent because the tensile strength of components formed from relatively inexpensive low carbon rolled stock is improved during cold forging.

New types of components are constantly being added to the list of cold forging applications, as designers become aware of the potentialities of the method. Complicated shapes can in many cases be produced in only one pass and often require no further finishing operations. The essential surface treatment remains effective after the completion of the components which can then be stored for prolonged periods without any further protection against rust or corrosion.

Many attempts have been made during the last 60 years or so to reach a practical application of the underlying principles of the process and have met with varying success. However, it is only comparatively recently that the detailed study of the parameters involved led to the development of machines which have revolutionised the manufacture of a variety of components, from nuts and bolts to highly complex parts currently produced by this technique.



Some of the range of components produced by cold forging.

Charts Give Diesel Output at Given Site

Since the performance of a diesel engine varies with conditions of altitude and temperature, corrections must be made from one site to another. New diagrams allow immediate conversion of power, efficiency and consumption.

By Soren Hansen

Chief Engineer, Diesel Design Department, Burmeister and Wain

THE diagram with which this article is concerned emanated from the work of a committee appointed by CIMAC (the International Congress on Combustion Engines) for drafting recommendations for the testing of diesel engines. During this work it proved desirable to establish that the outputs stated in contracts and specifications must always be those which the engines are to develop in their places of service—that is, for example, on the site at high altitudes for stationary engines and under tropical conditions in the case of engines for ocean-going ships.

By using the diagram, the question of a general and common reference condition, about which it will hardly be possible to reach international agreement, may be dropped. In the case of small engines manufactured for stock, for which the site is not known at the time of the test, the supplier may, for example, state the output under the atmospheric conditions in his workshops, and the output under any other conditions can then be obtained directly from the diagram. A single reference line corresponds to a given set of atmospheric conditions and the use of tables and graphs prepared for each particular atmospheric condition is thus eliminated.

By means of the diagram it is easy to convert a specified engine output into an output under the conditions existing during the testing in the engine builder's workshops, and thus ensure that the output stated for the engine is always the output which, according to the contract or specification, it is to develop in its place of service.

CHARGE COMPOSITION EFFECTS

During combustion, oxygen is used and the temperature of the gases in the cylinders is increased. The output energy of an engine during a cycle may be limited either by the weight of oxygen or by the weight and specific heat of the gases that are trapped in the cylinder during combustion that is, by the oxygen/fuel ratio or the thermal loading.

The thermal loading limitation does not usually give as sharp a definition as the oxygen-fuel ratio limitation, but may be determined out of regard to life expectation of engine components and maintenance cost. It is thus based on actual service experience and may not necessarily be disclosed by comparatively short shop tests.

NON-TURBOCHARGED ENGINES

The following considerations apply to normally aspirated four-stroke engines and to two and four-stroke engines in which scavenging and pressure-charging, if any, are effected by means of mechanically driven blowers (piston pumps, Root's, rotary, and centrifugal blowers) for which the ratio between the speed of the charging blower and of the engine is fixed and remains unchanged with changed atmospheric conditions.

For a given engine in this category the composition and weight of the air charge trapped in the combustion space before ignition is proportional to the ambient atmospheric conditions.

If the permissible engine output is therefore determined under one set of ambient conditions, experience shows that the permissible output under another set of ambient conditions can be predicted by a formula of the type:

$$\frac{N_{i2}}{N_{i1}} = K = \left(\frac{T_1}{T_2}\right)^n \times \frac{P_2 - \phi_2 P_{s2}}{P_1 - \phi_1 P_{s1}} \quad . \quad . \quad (1)$$

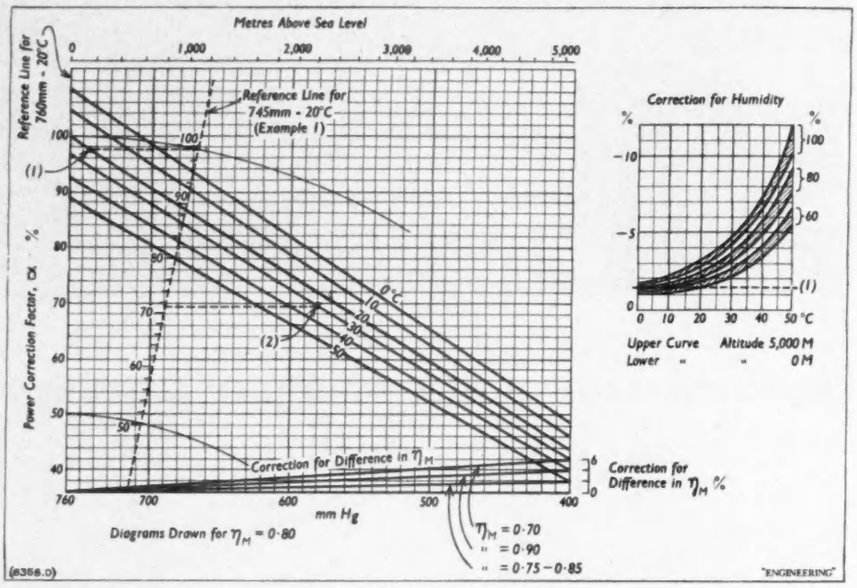


Fig. 1 Power corrections for altitude and humidity.

and

$$\frac{N_{e1}}{N_{e2}} = \alpha = K(1 + C) - C \quad . \quad . \quad . \quad (2)$$

where N_i = indicated output; N_e = effective output; T = absolute ambient temperature; P = absolute ambient pressure; P_s = partial pressure of saturated water vapour; ϕ = relative humidity; and C is a term dependent on the mechanical efficiency η_m (see appendix). The suffixes $_1$ and $_2$ refer to the operating conditions.

For engines that are limited by oxygen content K is proportional to the ambient oxygen density, i.e., to

$$\frac{P - \phi P_s}{T^n} \quad .$$

Note that in this case the partial pressure of the water vapour has to be subtracted from the absolute atmospheric pressure.

The specific heat per mole of water vapour is, however, of the same order of magnitude—even a little larger—than that of the other gases present in the engine cylinder before and after combustion. Therefore, it accumulates its share of the heat released during combustion and thus the temperature increase will not be higher than if the intake air had been dry.

For engines limited by thermal loading, K is therefore proportional to $\frac{P}{T^n}$ and experience seems to indicate a value for n of about 1 and for engines limited by oxygen content to about 0·75.

However, the temperature ratios $\frac{T_2}{T_1}$ encountered in practice rarely exceed 1·1 which gives $\left(\frac{T_2}{T_1}\right)^{0{\cdot}75} = 1{\cdot}074$, corresponding to a difference in estimated output of only about 2·5 per cent, and it is thus of little importance whether one or the other exponent is used in formula (1). The diagram Fig. 1, gives reduction values corresponding to exponents of 1 for formula (2) and 0·75 for formula (1).

The formulae are not convenient to work with,

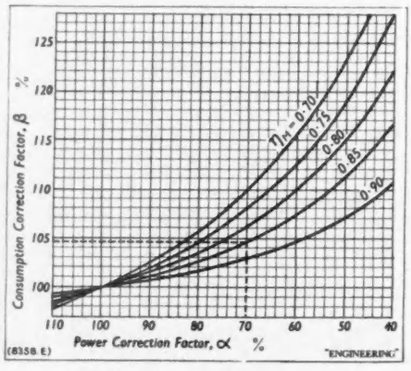


Fig. 2 Consumption correction.

and up to now attempts to simplify the calculations either by simple subtraction rules (which lack in accuracy) or by tables have led to adoption of reference ambient conditions on which the nominal outputs of engines are based. As mentioned in the introduction such reference conditions are rendered quite unnecessary by using the diagram Fig. 1, and furthermore to reach international agreement on one set of reference conditions would be impossible.

The modification of the output of turbocharged engines in accordance with atmospheric conditions depends to a certain extent on the characteristics of the turbochargers and their adaptation to the engines. If the turbo chargers are not modified or readjusted the above formulae and diagrams will generally be satisfactory for estimating outputs in accordance with atmospheric conditions.

POWER CORRECTION DIAGRAM

Fig. 1 shows the diagram in a convenient form for practical use. It is based on equation (2) with $n = 1{\cdot}0$ and with a C value corresponding to $\eta_{m1} = 0{\cdot}8$ and $a = 0{\cdot}7$ (see appendix). The choice for basic ambient condition $T_1 = 273 + 20°$ C and $P_1 = 760$ mm Hg has been made because higher air densities are normally not used

for reference. The diagram includes air pressures down to 400 mm Hg, and besides the pressure scale, the abscissa has a scale for the altitude above sea level. The latter scale is not linear. Further, circular arcs are shown for $\alpha_1 = 1{\cdot}0$ and $0{\cdot}5$.

If it is desired to draw a reference line for another condition, T_1' P_1', this point is found on the diagram and a horizontal line drawn through it from the vertical axis to intersect the arc drawn for $\alpha = 1$, the length of the intercept being L. An horizontal intercept of length $l = 0{\cdot}574$ L is then drawn to the arc for $\alpha = 0{\cdot}5$ and the new reference line is drawn through the intersections and graduated (see appendix, Fig. 5).

If the influence of the air humidity were to be included in the main diagram, too many lines would result, and it has therefore been deemed most expedient to include this influence in a separate correction diagram.

On the main diagram have been drawn correction lines for $\eta_{m1} = 0{\cdot}7$, $0{\cdot}75$, $0{\cdot}85$ and $0{\cdot}90$. These correction lines are used in the following way: Subtract the correction for air humidity γ from α. From the point $(\alpha\text{-}\gamma)$ on the 760 mm Hg 20°C reference line draw a horizontal line to the 20°C temperature line. Against the atmospheric pressure thus determined, the correction for alteration of the efficiency η_{m1} is read.

As appears from Fig. 1, the correction to η_{m1} for humidity will in most instances be so small that it may be ignored, because the correction for humidity will rarely exceed 8 per cent. The use of the diagram will later on be illustrated by examples.

EFFICIENCY AND CONSUMPTION

A change of the engine output from the value at which the mechanical efficiency η_{m1} is given, changes the efficiency in the proportion: $\frac{1}{\beta} = \frac{N_{e2}}{N_{i2}} = \frac{N_{e1}\,\alpha}{N_{i1}\,K}$ which by means of (2) is converted into $\frac{1}{\beta} = \eta_{m1}\frac{\alpha}{K} = \eta_{m1}\frac{1+C}{1+\frac{C}{\alpha}}$

The curve for β in relation to α is shown in Fig. 2 for different values of η_{m1} and with $a = 0{\cdot}7$.

When the engine output is converted according to the above formulae, the ratio between the charge weights (or the excess of air) remains constant, and the consumption per i.h.p.hr of the engine may also—provided the adjustment of the engine remains unchanged—with sufficient accuracy be regarded as unchanged.

Thus, the consumption per b.h.p.hr depends only on the change in the mechanical efficiency and can be expressed by:

$$b_{e2} = \beta\, b_{e1}$$

where b_e is the fuel consumption per b.h.p.hr.

EXAMPLES

(1) Draw reference lines for a test-bed for which the average ambient conditions are 745 mm Hg, 20° C, $\phi = 0{\cdot}6$.

Solution:

From the point (1), Fig. 1, which represents the mentioned test-bed conditions, a horizontal line is drawn to the arc $\alpha = 100$. The intercept L is measured as 21 mm, $l = 0{\cdot}574 \times L = 12$ mm is marked off on the arc for $\alpha = 50$ and the reference line is drawn. A horizontal line through 20° C and $\phi = 0{\cdot}6$ is drawn in the correction diagram for humidity.

(2) Under the above test-bed conditions, the following results were obtained: Continuous output, 1,000 b.h.p.; mechanical efficiency, 0·85; b_{e1}, 165 gm per b.h.p.hr.; load limit, air excess. The engine site has the following conditions: 2,200 m above sea level, 30° C, and $\phi = 0{\cdot}85$. It is desired to determine output, mechanical efficiency, and fuel consumption under these conditions.

Solution:

Horizontal line from point 2 (Fig. 1) gives $\alpha = 0{\cdot}71$.

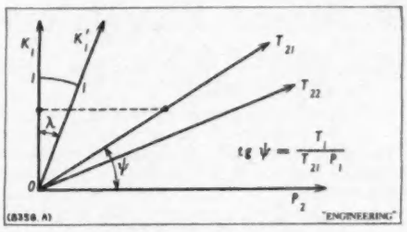


Fig. 3 Determination of ratio K.

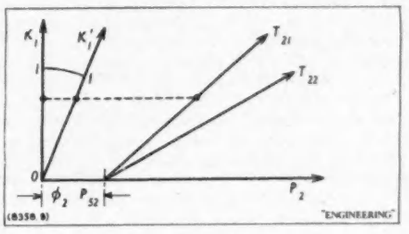


Fig. 4 Allowance for humidity.

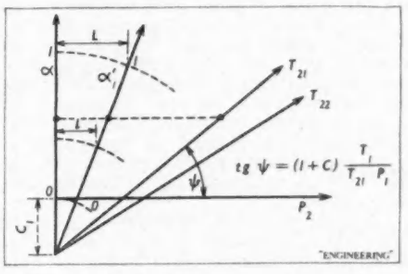


Fig. 5 Combined correction for output.

Correction for efficiency .. + 0·01
Correction for air humidity .. − 0·02
$\alpha_2 = 0{\cdot}71 + 0{\cdot}01 - 0{\cdot}02 = 0{\cdot}70$.
$N_{e2} = 1000 \times 0{\cdot}70 = 700$ b.h.p.
From Fig. 2,

$\beta = 1{\cdot}045 \quad \eta_{m2} = \frac{0{\cdot}85}{1{\cdot}045} = 0{\cdot}815$

$b_{e2} = 1{\cdot}045 \times 165 = 172$ gm per b.h.p.hr.

(3) Under test-bed conditions like those in example 1, the following figures were obtained: Continuous output, 20 b.h.p.; mechanical efficiency, 0·70; b_{e1}, 200 gm per b.h.p.hr. The engine site has the following conditions:

0 m above sea level; 40° C, and $\phi = 1{\cdot}00$

It is desired to determine the output, mechanical efficiency, and fuel consumption, with correction in efficiency due to the air humidity correction.

Solution:

Horizontal line from point 760 mm Hg, 40° C gives $\alpha = 0{\cdot}95$.
Correction for air humidity .. 0·05
As $0{\cdot}95 - 0{\cdot}05 = 0{\cdot}90$, to which corresponds $P_2 = 695$ mm Hg, then
Correction for efficiency .. 0·01
$\alpha = 0{\cdot}95 - 0{\cdot}05 - 0{\cdot}01 = 0{\cdot}89$
$N_{e2} = 20 \times 0{\cdot}89 = 17{\cdot}8$ or approximately 18 b.h.p.

$\beta = 1{\cdot}03 \quad \eta_{m2} = \frac{0{\cdot}70}{1{\cdot}03} = 0{\cdot}68$

$b_{e2} = 1{\cdot}03 \times 200 = 206$ gm per b.h.p.hr.

APPENDIX

For types of engine listed, the following relation may be assumed to apply between the indicated outputs at two different atmospheric conditions, designated by suffixes 1 and 2:

$$K = \frac{N_{i2}}{N_{i1}} = \left(\frac{T_1}{T_2}\right)^n \frac{P_2 - \phi_2 P_{s2}}{P_1 - \phi_1 P_{s1}} \quad . \quad (1)$$

The vapour pressure is only deducted in case of engines whose load limit is determined by air excess, while it is not deducted in case of engines whose load limit is determined by thermal load, because the specific water vapour is of the same order of magnitude as that of the other gases present in the combustion space.

Considering the latter group of engines first, and assuming the exponent $n = 1$ then:

$$K_1 = \frac{T_1}{T_2 P_1} P_2 \quad . \quad . \quad (3)$$

If suffix 1 applies to a given condition, e.g. the condition of the test site, then from Fig. 3, for a given value of T_2, K is determined by the ordinates to a straight line with point of origin $K = 0$, $P_2 = 0$ and with $\tan\psi = \frac{T_1}{T_2 P_1}$. The K-value for a point corresponding to simultaneous P_2 and T_2 values is thus given by the ordinate of the point.

If it is desired to use the values T_1' and P_1' for reference instead of T_1, P_1, $\tan\psi$ is altered in the ratio $\frac{T_1'}{T_1}\frac{P_1}{P_1'} = j$.

If the values $\frac{T_1}{P_1}$ have been chosen so that $\frac{T_1'}{P_1'} > \frac{T_1}{P_1}$ we have $j > 1$, and the alteration of $\tan\psi$ to $\frac{T_1'}{T_2 P_1'}$, is equivalent to a reduction of the length of the K_2 scale in the proportion $\frac{1}{\gamma} = \cos\lambda$, i.e. the K_1' values are read on the original scale turned an angle λ from the ordinate axis.

The equation $K = \left(\frac{T_1}{T_2}\right)^n \times \frac{P_2}{P_1}$ is represented by a similar graph.

If the air humidity is to be considered, equation (1) may also be graphically represented, as the abscissa for $K_1 = 0$ is $P_2 = \phi\, P_{s2}$ and

$$\tan\psi = \left(\frac{T_1}{T_2}\right)^n \times \frac{1}{P_1 - P_{s1}} \text{ (Fig. 4).}$$

The scale lines are hereinafter called reference lines.

The effective output

The reduction factor for the effective engine output:

$$\alpha = \frac{N_{e2}}{N_{e1}} = K - a(1-K)\left(\frac{1}{\eta_{m1}} - 1\right). \quad (4)$$

where a is that part of the lost indicated output $N_{i1} = N_{i1}(1 - \eta_{m1})$ which is independent of the atmospheric conditions, and $(1 - a)$ that part of the lost indicated output which is proportional to K.

$\eta_{m1} = \frac{N_{e1}}{N i_1}$ is the mechanical efficiency corresponding to the ambient condition of suffix 1.

Assuming $a\left(\frac{1}{\eta_{m1}} - 1\right) = C_1$ and substituting K from equation 3 we have:

$$\alpha = K(1 + C_1) - C_1$$
$$= \frac{T_1 P_2}{T_2 P_1}(1 + C_1) - C_1 \quad . \quad . \quad (5)$$

which in a coordinate system with the P_2 values as the abscissae are represented by lines with $\tan\psi = \frac{T_1(1 + C_1)}{T_2 P_1}$ and point of origin $P_2 = 0$; $\alpha = -C_1$ (Fig. 5).

In the same way as shown in Fig. 4, lines can be drawn which correspond to given air humidities, and as stated above, a change in the condition to T_1' P_1' corresponds to reading the α-scale turned an angle λ from the ordinate axis.

It appears immediately from Fig. 5 that at $\alpha = 1$ on any reference line corresponds to unchanged C_1 value, for which reason η_m is also unchanged for all $\alpha = 1$, but changed for all other conditions that are referred to this reference line.

Leaflets, with copies of the conversion charts enlarged to a practical size and with instructions for use, are available from ENGINEERING, *36 Bedford Street, London, WC2, at the price of 2s each, post free.*

On the Shelf

By Frank H. Smith

EACH year the daily press contrives to extract one item from the Library Association annual conference and this time it appears to be the Scottish Central Library's Mr. M. C. Pottinger's paper on a 14 day visit to Russia. He highlighted (highlit?) the Russian system whereby all the particulars are known of each reader and an exact record kept of his reading tastes over the years. Mr. Pottinger deplores this and said " I don't want any official checking up on the last 50 books I have borrowed. What a man chooses to read is essentially a private and personal affair."

I would suggest, in that case, that Mr. Pottinger buys his books and does not use a *public* library. Has Mr. Pottinger never had a client (as nearly every technical librarian must have had) who comes along and says " About three years ago I had a book out on the sex-life of the sea-snail or something like that—I can't remember the author. It was green and I borrowed it the day after my 74th birthday." If you keep the sort of record the Russians use, all you have to do is to ask the man when he was 74 (or is it 73?) and his record card will tell you the rest. Besides, I am sure that Mr. Pottinger knows all about market research. Has he never seen figures which show how many refuse-collectors in the new towns are reading the latest Daphne Du Maurier? This sort of thing comes from just such records as these perfidious Russians are keeping. Let us not seek menace where no menace is.

Tastefully covered in grey (aluminium?) with black print are *Nuclear Engineering Abstracts*, of which Volume One, Number One is dated July, 1960. It is a Silver End Documentary Publication emanating from 9-11 Tottenham Street, London, W1 (LANgham 7447). The coverage as outlined on the cover (no pun intended) is engineering materials, methods, apparatus; techniques in research, measurement, testing; science background and economics assessments. Six guineas, a quarterly (or $18·50 if you happen to read this in that part of the world) and that seems to be about all you will want to know as an appetite-whetter.

Now available (first issue 6 September) is *Electronics Weekly*, described as the only newspaper of the electronics industry. It's a Heywood job (Drury House, Russell Street, London, WC2) and if you want it I should try and get the pre-publication offer of 10*s* for 60 issues. (Tell them that Frank Smith told you too late for you to cash in on the pre-publication offer and ask them to stretch a point.)

For many years Chapman 'n' 'all have been synonymous in this country with Wiley of New York. From 29 August, however, John Wiley and Sons Limited operate as such from Gordon House, Greencoat Place, London, SW1 (VICtoria 0143). Mr. J. Durrant is the marketing manager and the managing director is Mr. Burgess Whiteside.

Those energetic Soviet material chasers, Consultants Bureau, of 227 West 17th Street, New York 11, now advertise *Soviet Science in Translation* at $25 for a year's 12 issues. This tells you what appears in the latest of 73 Soviet journals, when a translation will appear of any paper that interests you, whether you can get hold of any paper and a whole lot more gubbins.

In 1899, the August number of *Cassiers Magazine* was a special number devoted to The Electric Railway. 300 pages of it and covering the development of trams and electric railways in the UK, Europe and the States. The Light Railway Transport League (245-7 Cricklewood Broadway, London, NW2) is trying to arrange for a reprint of this classic and if you slap in a pre-publication order it will cost only 2 guineas as against £2 10*s* after. The reprint will be in stout covers and measure 8½ by 5½ in.

Defence Works on the Beaches

Coastal Changes. By W. W. WILLIAMS. *Routledge and Kegan Paul.* (28*s*)

Major Williams has been lecturer in surveying in the Department of Geography, Cambridge University, since 1938. As a major in the Royal Engineers during the Second World War he was concerned with determining the characteristics of enemy beaches for amphibious operations. Since then he has studied beaches on the east coast of England and in the Mediterranean, and has published several interesting papers on coastal matters. *Coastal Changes* is his account, from the geographer's point of view, of coastal forms and coastal movement.

The book begins with a review of general problems on the coast erosion of soft cliffs, movement of offshore bars, the prediction of beach levels for amphibious operations—and considers the geological background to these problems. The agencies causing the movement of material on the coast—waves, currents, gravity and wind—are then described. The author rightly emphasises the enormous amount of energy available in storm waves, and points out that each foot of wave crest may contain as much as 100 h.p. which will be released against a coast line to assist in its destruction. The statement that " since the velocities and lengths of waves are reduced as the waves advance up a beach their energy too is gradually diminished " should perhaps be clarified, since the energy is not significantly reduced until the waves begin to break; before then the reduction in velocity and wavelength is compensated by an increase in the height of the waves.

The chapter on coastal forms and changes is especially interesting, since the author puts forward theories to explain the growth of offshore bars, spits, and runnel and bar formations. These theories are illustrated with many examples taken from the coast of England and the Baltic. But the part played by waves in littoral drift is not always clearly explained; instead the action of tidal currents is continually invoked to explain the movement of material along the coast. When waves strike a beach at an angle they can produce very strong littoral drift. This effect is partly due to the action of the breaking waves in pushing sand obliquely up the beach and allowing it to return straight down the beach under gravity, thus producing a longshore drift of material, and partly caused by the strong longshore currents which are generated by the oblique waves. It is this mechanism, combined with the tidal currents, which is responsible for the littoral drift and which determines the regime of coasts at Yarmouth, Benacre Ness, Orfordness, Dungeness and Selsey, and explains the movement of beach materials on the north coast of Norfolk.

The author describes the use of Ordnance Survey plans, Admiralty charts and aerial photographs to show coastal changes, and mentions the method used during the war for determining the contours of enemy-held beaches from aerial photographs of waves approaching the coasts. The comparatively new technique of employing radioactive tracers to follow the movement of sand and shingle is discussed and the author suggests that other kinds of artificial stones should be used as tracers. In fact artificial pebbles marked with fluorescent tracers have recently been used by the Hydraulics Research Station to measure rates of littoral drift, and have been found to be much more convenient for work on beaches than radioactive tracers.

The danger of designing sea defences to protect only a short length of coast is explained, as is the function of sea banks, groynes, sea walls, and pneumatic breakwaters. Mention might perhaps have been made of the protective method based on artificial fill, which is now used extensively in the United States, although it is often considered too expensive for English beaches. Some very useful appendices are provided at the back of the book; they give graphical form to the fundamental equation $C^2 = \frac{9\lambda}{2\pi} \tanh \frac{2\pi d}{\lambda}$ and show how wave characteristics are related to wind velocity, fetch and duration.

Major Williams has written a book of great interest to students of coastal problems and practising engineers. The work should stimulate thinking on coastal questions and is a valuable addition to the available literature.

W. J. REID

Nothing New in the Motor Car?

Science Museum: Handbook of the Collection Illustrating Motor Cars. By C. F. CAUNTER. Part 2: Catalogue of Exhibits with Descriptive Notes. *HM Stationery Office.* (10*s* 6*d*)

Museum catalogues do not enjoy a reputation for entertainment; nor do they, in many cases, afford interesting reading outside the walls that house the collections to which they refer. The Science Museum's *Motor Cars: Handbook of the Collection*, by C. F. Caunter, is a notable exception. It contrives to provide a wealth of information in terms to which no engineer could take exception, and at the same time to give its information in words a layman could understand. It does not " talk down."

Quite clearly its first function is to describe the exhibits as they appear before the eyes of the beholder; but to an enthusiastic motorist it makes the most delightful bedside reading. Its power to evoke memories of the past must delight the older generations, while the young may find fascinating descriptions of ideas they have probably never met before. Carburettors range from wick vaporisers to these modern multi-jet affairs. The magnificent curiosity of the Hayes transmission serves to remind us that infinitely variable gears are not new. Indeed a study of any individual section establishes, even more clearly than popular legend, that there is nothing new under the sun.

The book is copiously illustrated with good photographs and is pleasantly laid-out. There is an index, and a list of donors, not to mention mysterious lists of figures which refer to an inventory and a catalogue of obviously greater import and significance than this one.

Each section begins with a concise but charming survey of the development in its own particular sphere; but the greatest mystery of all remains unsolved. Clearly printed on the neat blue cover we find, among other letters, the words " Part II." What then of part one? Research in Stationery Office windows in the principality of Wales leads one to suppose that " Part I " is motor cycles . . . . I wonder.

Automobil Revue: Katalog Nummer 1960. *Automobil Revue, Nordring* 4, *Berne.* (8·50 *Sfrs*)

The English, one feels, are not naturally good at languages; and books which appear in foreign tongues are therefore both suspect and tantalising. Sometimes they are only printed words; and it may then be impossible even to know what the volume is about. On the other hand like the 1960 special annual issue of *Automobil Revue*, they may be so full of remarkable illustrations that it is hardly necessary to understand the words at all.

And, of course, there is the question of luxury. Whatever the language, the appearance of a book also counts; and there is something especially splendid about an oversize magazine format—a certain tactile pleasure in the handling that, mingled with the scent of coloured inks,

produces in the reader a sense that in his hands is something of substantial worth and importance.

The constant "rationalisation" of models throughout the world's motor industry has acted as a law of dimishing returns when it comes to a survey of a year's new cars. For us in England however, there is always something new; there, are usually a few models not available to us because of import and export restrictions; and if nowadays the current American productions are generally on display at Earl's Court, then at least we need pictures to keep us up to date with the present splendours of the Italian coach-building industry.

Apart from complete specifications, with a small section actually in English, the special catalogue number of the *Automobil Revue* ranges widely over the whole of the world's automobile construction. There is also a principle feature on styling which recalls the splendours of the past and at the same time provides a critical survey of present trends. Motor sport also has its place, and there is a review of some less familiar developments, including various forms of "hovercraft."

Not the least interesting and satisfying of its pages are those of the many advertisers which offer not only a survey of the world's cars but a quick and thorough review of art departments in the world's advertising agencies. It is a volume for browsing through rather than reading in detail and, of course, a volume of reference—this more than anything else. Here it may not be unique; but it is as comprehensive as any, and more luxurious than most.

L. KLEMANTASKI

Birds Cannot Fly at Supersonic Speeds

Theory of Flight. By RICHARD VON MISES. *Dover Publications, New York; Constable, London.* (20*s* 6*d*)

Theory of Wing Sections. By IRA H. ABBOTT and ALBERT E. VON DOENHOFF. 2nd edition. *Dover Publications, New York; Constable, London.* (21*s*)

Von Mises's account of the theory of flight was written as a text-book for students and engineers, and is admirably suited to this purpose, being both comprehensive and detailed in its treatment of the subject. Transonic and supersonic flight were only hopes for the future when the book was being written, so the reader will not find any theory of high-speed flight therein; nor is there to be found any mention of jet propulsion. After an introductory section on the atmosphere and air-flow, von Mises deals in turn with aeroplane wings, propellers and engines, performance, and control and stability. Each subject is developed from first principles, and it is this fact that allows the work to retain its value today.

There is a modern tendency current among students to discount the theory of low-speed flight on the ground that it is less interesting than that of high-speed flight, and to consider that most of what was written before 1950 must now be out of date and unworthy of serious study. This view may be understandable, but it should be opposed when and wherever it is met, because the theory of high-speed flight is based firmly on principles which were first established for low-speed flight. These principles were formulated slowly and painfully by men of genius, among whom we may include von Mises; they now appear to us as being intuitively obvious, and we recognise various features of aeroplanes as looking "right", or not, as the case may be.

But supersonic aeroplanes do not always look "right" even when they are; this is partly because we have not become used to their appearance, and may also be due to the fact that Nature has not produced animals which fly at supersonic speeds. Thus we have little experience and no natural guides to follow, and a correct appreciation and application of aero-mechanical principles becomes more important than ever. The easiest way to learn the principles is in the context of low-speed flight, and a textbook of the kind under review is just what is required for this purpose.

Abbott and von Doenhoff's *Theory of Wing Sections* is of a rather different nature. The subject matter of the first part of the book is indicated by the title, and is mainly concerned with two-dimensional flow; it includes chapters on wing sections of finite thickness, thin wing sections, effects of viscosity, experimental characteristics of wing sections, high lift devices, and effects of compressibility at subsonic speeds. Transonic and supersonic flows are not covered. The second part of the book (the appendices), which contains more pages than the first part, consists of data for the more commonly used NACA aerofoil sections at subcritical flight speeds.

Although the first part can be used as a text-book, the work as a whole was intended to serve primarily as a book of reference; it has been used extensively for this purpose, and it should continue to do so for a long time.

The former of these two books was first published in 1945, and is now reprinted unchanged; the latter was first published in 1949, and the new edition by Dover Publications is a corrected version of the original. Both are well established in the literature of aeronautics.

G. N. WARD

Interpreting Congestion for the Traffic Engineer

Roads and Their Traffic. Edited by ERNEST DAVIES. *Blackie.* (35*s*)

Ernest Davies is to be congratulated on bringing together in one book the views of so many experts in their own particular fields of traffic engineering and for the admirable summing up he himself makes in the final chapter. So great is the authority of the contributors that it would be rash to offer any technical criticism.

Traffic congestion and road casualties are topical subjects and much has been said on them in recent debates in Parliament. This collection of lectures is therefore well timed. To whom should they appeal? The mass of facts, figures, data and suggestions may be bewildering to the reader who has no knowledge whatsoever of this comparatively new science but should be invaluable to those young graduates who are now starting on specialised courses to form, we hope, the nucleus of an army of traffic engineers that are so earnestly needed for the future.

One is not unnaturally attracted to those parts of the book that deal with urban congestion. Good highway engineering, money, equipment, and backing by the Government should give us the regional motorways that we so urgently require throughout the country to link up our big cities, but it is the difficulty which arises when these motorways reach the conurbations, and the congestion that follows, that is such a vital problem about which some action must immediately be taken. And, as London is our capital city and the place where the problem of urban congestion is greatest, I was a little disappointed that none of the contributors was prepared to "stick his neck out" by offering a plan for London.

What then can we do? Traffic engineers are not born in a day; there is a misconception that if you give a traffic engineer adequate data he can solve the problem on paper. There is nothing further from the truth. It is necessary first to know your ground, and indeed your local authorities, intimately. We cannot afford to wait, so the problem must be handled by the small band of experienced traffic engineers we have, the highway engineers who have grown up with the problem for many years and the policemen who by virtue of their experience of traffic conditions 24 hours a day, seven days a week, are in a position to initiate ideas and provide the opinion whether a scheme will or will not work.

Police know so much about driver behaviour and local conditions; for instance, a layout may be attractive in theory but confusing in practice; a signposted route devised to eliminate a heavy right-hand turn may not be used, to the detriment of an already heavy right-hand turn at the next junction; a broken down vehicle, a not uncommon occurrence, can completely negative a one-way scheme if one of the streets is too narrow. Not all these points are immediately appreciated by other parties.

London traffic problems are complex. Congestion in the centre is severe and is caused as much by the sheer weight of traffic as the waiting vehicle. It would never, it is hoped, be necessary to restrict anyone from entering central London if he so desired. Neither, on the other hand, do we wish congestion to be so acute that business people would become frustrated, move out and leave London with a soft centre. What is the solution?

No one wants to see London desecrated by elevated highways at second-floor level or scarred by cuttings dividing communities in half, but it should not be beyond the wit of the engineer to find a route for an inner ring road some two or three miles from the centre. It is bound to be expensive but costs should be compared with savings that would result. Inside the ring, short-term parking can be controlled by parking meters and no-waiting restrictions rigidly enforced; a certain number of medium-sized garages can be provided for the long-term parker, but not so many as to cause a traffic problem of their own at peak hours.

Radial routes can feed into the ring road which should connect most of the main line railway stations where cheaper garages, with bus stations and taxi standings to allow for quick transport into the centre, can be situated. With the vast volume of people that have to be brought into central London daily, public transport has a tremendous part to play because any increase in the number of private vehicles entering the centre can only lead to chaos.

But these improvements would take years to achieve. Can we thus find any palliative meanwhile to improve the circulation of traffic in central London and help our radial routes? There has been some wild talk, stimulated by the opinion of American traffic experts based on the briefest of visits, about one-way streets and tidal flows. In fact, the centre of London is honeycombed with minor one-way systems but only those who have fully studied the effects of making some of our main arteries one-way can appreciate the very great difficulties that

Continued on next page

more than outweigh, on our present layouts, any advantage gained. In the absence of bays for buses and goods vehicles, one needs, in order to establish a tidal flow morning and evening, two lanes in the opposing direction. What roads have we in London, constructed in the main to suit tram tracks, that will accommodate five lanes, the least number essential for tidal traffic arrangements? Virtually none.

A fascinating problem at the moment is to what extent we can turn out present radial routes entering London into clearways so that the inevitable delay between the end of the motorway and the centre of the city can be avoided. By complete elimination of the waiting vehicle and by blocking accesses, which in themselves could provide space for bus stops and vehicles wishing to unload, and by possibly restricting use by the slower vehicle, traffic could be brought into London at faster speeds. What to do with it when the bottleneck is eventually reached would be a further problem to solve.

Origin and destination surveys for all traffic entering London are advocated, but there danger that by the time the results are obtained and collated, the position will have changed. The pattern of traffic into London varies even day by day, but it flows in like water, so that whatever additional artery or carriageway can be provided, it is certain that it will be fully used. Motorists are prepared to travel further if they can save journey time. If the radial routes enter an inner ring road, drivers can leave at the point they desire and this will be particularly valuable in the case of heavy vehicles proceeding to and from the docks which at present so clutter up our central thoroughfares.

However much the free flow of traffic is improved, it will be wasted if a complementary reduction in the number of casualties is not obtained, and it is pleasing to note how all the contributors in the book appreciate this. With our present roads, the yearly increase of vehicles is bound to lead to a rise in the number of accidents, but if their capacity is enlarged—M 1 is a special example—the tide can change. The standard of driving in this country is not high and even mature motorists allow themselves to become impatient and do stupid things because of congestion on the roads. So the driver must be protected from himself. If we grade segregate pedestrians, eliminate direct cross-overs and right-hand turns, collisions are not so inevitable; if we improve the surface of the road, skidding errors are less probable, and if we can better the sight lines and eradicate three-lane highways, overtaking will not be such a problem. The thought that has been given to the subjects of "Road Signs and Markings" and "Road Lighting" has been a significant contribution towards road safety. The more the motorist can be controlled and regulated, the more he can be divorced from other road users—for he is the man in charge of the lethal weapon—the less will be our accident problem.

What a stimulating problem this traffic engineering can be! Because there is no end and no final solution, Mr. Davies's book will do much to assist our young traffic engineers to think in the right direction and I hope will induce fathers to put their sons into an interesting profession.

JOHN L. WALDRON

New Books

Applied Mechanics for Engineers. By JAMES C. GRASSIE. Longmans. (45*s*)

The author has treated three separate branches of applied mechanics in this volume—statics, dynamics and strength of materials—and by means of cross-references attempts to show how they are co-related. The level of treatment is suitable to the first two years of an undergraduate course, and the addition of worked examples makes it suitable for independent study.

Financial Analysis for Management. By RONELLO B. LEWIS. *Prentice-Hall, Englewood Cliffs, New Jersey and London.* (200*s*)

A guide to the appraisal of financial factors for the purpose of top-level decisions on policy, written by an executive with experience at vice-presidential level of at least five mergers.

Why People Buy: Motivation Research and its Successful Application. By LOUIS CHESKIN. *Business Publications Ltd.* (35*s*)

A discursive account of the practice of consumer market research by one of America's leading practitioners of the art.

Electrical Who's Who, 1960–61. 6th edition. *Electrical Review Publications Ltd., Dorset House, Stamford Street, London, SE1.* (35*s*)

The new edition contains some 9,000 biographical entries for men and women in all branches of the electrical industry, supplemented by an index arranged under the names of their companies or other organisations.

Mechanical Properties of Structural Materials at Low Temperatures. By R. MICHAEL MCCLINTOCK and HUGH P. GIBBONS. National Bureau of Standards Monograph No. 13. *US Government Printing Office, Washington, DC; HM Stationery Office, London.* (13*s* 6*d*)

A compilation of 176 pages of graphs from 104 listed sources, and covering aluminium, copper, nickel, titanium, and their alloys, magnesium alloys, austenitic, ferritic and hardenable stainless steels, low alloy constructional steels, superalloys, brazing and soldering metals, and nonmetallic materials.

Bessel Functions. Part 3: Zeros and Associated Values. Edited by F. W. J. OLIVER. Royal Society Mathematical Tables, Volume 7. *Cambridge University Press.* (50*s*)

Most of the previous volumes in the series contain values of some formally defined mathematical function at sets of piecewise equidistant values of some argument. However, in some types of physical and mathematical problems it is not the values of the function for a set of its arguments which are of major interest, but the values of the argument for which the function vanishes—its zeros, in fact.

Medical Electronics. Proceedings of the 2nd International Conference on Medical Electronics, Paris, June, 1959. Edited by C. N. SMYTH. *Iliffe.* (145*s*)

Some 160 papers were presented at the conference, grouped broadly into sections as follows: electrophysiological techniques, electroencephalography, cardiology, manometry and flow measurement, acoustic techniques, automation in medicine, radiology and isotopes, and chemical instrumentation.

Practical Welding Repairs. By C. G. BAINBRIDGE. *Temple Press.* (15*s*)

Written for the repair welder, this book covers the three main areas of the field: castings, sheet metal, and the rebuilding of worn parts. A section on the care of equipment is included.

Temperature Measurement and Control. By W. F. COXON. *Heywood.* (60*s*)

Intended as an introduction to industrial practice, the early chapters present basic physical data while the remainder of the book is given over to a discussion of instruments and control methods.

Decisions, Values and Groups. Edited by DOROTHY WILLNER. Volume 1. *Pergamon Press.* (80*s*)

A collection of scientific reports from the First Interdisciplinary Conference in the Behavioral Science Division, sponsored by the United States Air Force Office of Scientific Research.

The Reviewers

Mr. W. J. Reid, M.A., M.A.I., A.M.I.C.E., is senior scientific officer at the Hydraulics Research Station, Wallingford, in the Department of Scientific and Industrial Research.

Mr. Louis Klemantaski is both a leading professional photographer and himself a keen *aficionado* of the automobile, being particularly noted for his pictures of the motor car in action.

Professor G. N. Ward, M.A., occupies the chair of mathematics at the College of Aeronautics, Cranfield.

Mr. John L. Waldron, B.A., is Assistant Commissioner (Traffic and Transport) in the Metropolitan Police. He has previously served with the Ceylon Police, has acted as Deputy Inspector-General in the CID, and before returning to Scotland Yard was Assistant Chief Constable of Lancashire and Chief Constable of Berkshire.

Trade Publications

Copies of any of the following trade publications are obtainable from the addresses given, though distribution is sometimes restricted.

Handling

Feeders and Separators. MAGCO LTD., Lake Works, Portchester, Hants. Magnetic separators, vibrators, feeders and crack detectors made by the firm, illustrated in publication 112.

Vibrating Feeders. LOCKER INDUSTRIES LTD., Warrington. Natural frequency vibrating feeders for most materials. Illustrated catalogue.

Loader. NCK-RAPIER LTD., 32 Victoria Street, London, SW1. The 205 Skooper will stand still load up to 350 tons per hour. Crawler mounted. Full details given in publication 205/7.

Dumper. AVELING BARFORD LTD., Grantham. Model SL 270 dumper has 13½ ton capacity, 47 ft turning circle. Full description in brochure 1810.

Handling Equipment. J. COLLIS AND SONS LTD., Regent Square, Gray's Inn Road, London, WC1. Various types of handling equipment made by the firm including trucks, horizontal and vertical conveyors. Leaflet.

Trailer. TASKERS OF ANDOVER LTD., Waterloo Iron Works, Andover, Hants. The "4-Seasons" two wheel trailer for general purposes. Several versions with extendible sides and demountable bodies. Illustrated leaflet.

Lift Trucks. W. LANGLEY AND CO. LTD., 14-16 Magdalen Street, London, SE1. "Jacacaddy" lift trucks; range of models and types of operation listed in 20 page catalogue.

Conveyors. HERBERT MORRIS LTD., PO Box No. 7, Loughborough, Leics. Overhead and ground conveyors of slat, belt, trough, roller, and chain types. comprehensive list of illustrated examples given in booklet 242.

Mobile Crane. RANSOMES AND RAPIER LTD., Waterside Works, Ipswich. Mobile type 1520 for loads up to 15 tons with booms up to 80 ft. Pneumatic tyres, diesel engine powered. Illustrated brochure 1/532.

Timber Handling. MATBRO LTD., Fork Truck Division, Horley, Surrey. Series III fork trucks for timber handling; gripping arms, high capacity, good ground clearance. Leaflets give range.

Tower Cranes. BABCOCK AND WILCOX LTD., 209 Euston Road, London, NW1. Babcock-Weitz tower cranes, variable height, horizontal jib for loads up to 15 cwt at 65 ft radius. Illustrated leaflet gives varieties.

Materials Handling. HOLDAN ENGINEERS (LONDON) LTD., 119 Victoria Street, London, SW1. Examples of pneumatic conveyors for ash dust and sand given in leaflet.

Overhead Runways. COBURN ENGINEERS LTD., Peasmarsh, Guildford, Surrey. Overhead runways for hoists, conveyors, etc., used in battery farming, breweries, and factories. Section 6 of main catalogue, illustrated examples.

Lifting Magnets. GENERAL ELECTRIC CO. LTD., Erith, Kent. Witton-Kramer lifting magnets of 30 to 80 in diameter. Full technical description and table of capacities given in bulletin 379.

Overhead Conveyors. BRITISH MONORAIL LTD., Wakefield Road, Brighouse, Yorks. MonoRail overhead systems, hand or power operated. Standard sections, rails, points, and trolleys, Bulletin 23.

Conveyor. J. COLLIS AND SONS LTD., Regent Square Gray's Inn Road, London, WC1. The Slatveyor for handling general goods on the level or on inclines. Design details given in brochure.

Shop Crane. RANSOMES AND RAPIER LTD., Waterside Works, Ipswich. Shop truck crane, diesel-electric with cushion tyres; 12 to 17 ft telescopic jib, 1·35 tons load. Publication 8/467.

Marketing

BEA Reaches 500,000 A Month

BRITISH EUROPEAN AIRWAYS has for the first time flown 500,000 people in a single month (July). Lord Douglas of Kirtleside, the BEA chairman points out that the two largest airlines in the world, AMERICAN AIRLINES and EASTERN AIRLINES, carry about 800,000 passengers a month each. BEA has now reached 60 per cent of this level and Lord Douglas is plainly looking ahead.

The BEA traffic rate for July was 23 per cent above the level of July, 1959, and the growth rate of 20 per cent is thought to have been reached in August. The total revenue of the corporation in July exceeded £5 million—the first time the corporation's income has gone this high in a single month.

Fast Growing Israeli Airline

While Lord Douglas of Kirtleside chronicles the advance of British European Airways, El Al, the Israeli airline, continues its rapid expansion.

Founded eleven years ago El Al first flew over routes extending only to Rome and Paris. It has now built up to a 19,000 mile network over four continents. El Al was the first overseas airline to use the Bristol Britannia and was also the first to make a non-stop flight between New York and Tel-Aviv, the longest flight made by a civil airliner. Next year the big Boeing 707 jets will be operating over the El Al network.

From its early days when air and ground staff were drawn from the United Kingdom, the United States, Canada, and South Africa, the airline has advanced to the point where one of its captains has been loaned to another airline for training purposes.

AEI Cable Contract for Spencer Steelworks

ASSOCIATED ELECTRICAL INDUSTRIES are to start work soon at the new Spencer Steel Works, Newport, South Wales, of RICHARD THOMAS AND BALDWINS on a cable contract worth more than £500,000.

Fifteen miles of 3-core and 2½ miles of single core solid type 33 kV cables are to be installed plus 20 miles of 11 kV 3-core cables and 4 miles of 11 kV single core cables.

Construction has now been going on for a year at RTB's Newport site where the Spencer works is being built on reinforced concrete piles.

New £4 million Coking Plants

Orders for two new coking plants, worth more than £4 million together, have been placed with the WOODALL-DUCKHAM CONSTRUCTION Company.

COLVILLES have ordered two batteries of coke ovens with complete coal and coke handling systems and a by-product recovery plant for the Ravenscraig Works. The new ovens will equal the coke capacity of the plant now being constructed. When all six batteries are in operation at the end of 1962, the Ravenscraig Works will be processing 1¾ million tons of coal a year.

The other coking plant has been ordered by the UNITED STEEL COMPANIES subsidiary UNITED COKE AND CHEMICALS. This contract covers demolition of a derelict battery of ovens and the construction of 43 new ovens with by-product recovery, benzole plants and a gas boosting plant. The building of the new installation will be complete by the end of 1962.

Modern Selling in 18th Century Setting

The FORD COMPANY have opened their new sales and management training centre in a small-scale 18th Century mansion, The Bower House, beside the Essex village of Havering-atte-Bower.

Courses lasting two or three days will be given for Ford dealers and sales managers. Five day courses will be run for dealers' salesmen concentrating on advanced selling techniques and on knowledge of Ford cars.

The company plans to pass 1,500 people through courses at the Ford Merchandising Centre every year. The £85,000 centre lies ten miles to the north of the Dagenham plant.

A careful programme of restoration has been carried out at the Bower House.

Built in 1729 by a well known lawyer, the Bower House was built very largely from the remains of the ancient royal palace of Havering. The palace had existed from Saxon days and had been visted by sovereigns from Edward the Confessor to Charles II.

Empire Markets Keep Up Farm Machinery Sales

The depressed condition of agricultural machinery sales in Britain has not been confined to this country alone. The latest report from MASSEY-FERGUSON shows a decline in sales in the United States and France as well. The position has been largely saved by the strong Canadian market, by better sales in Australia and Germany and by well maintained sales levels in Africa, Asia and Latin America.

Although the Massey-Ferguson net profit of $4·8 million in the third quarter (ending 31 July) was 3·5 per cent above the equivalent period last year, the sales—$131·3 million—were 4·7 per cent lower.

The overall world sales for Massey-Ferguson in the first three quarters of the 1960 financial year were 3 per cent down on the record sales of the same period last year.

Colonel W. E. Phillips, the Massey-Ferguson chairman and chief executive officer, has stated that the general experience of the farm machinery industry and of his company has been the same in the United States, the UK and France.

In addition to the more encouraging conditions in other markets the Perkins engine subsidiary has been expanding its operations in its principal markets.

Although the company does not expect any substantial change in the economic conditions affecting the sales pattern in the last quarter of the financial year, some improvement, it is thought, may occur in Britain and the United States.

How Much is Your Sales Force Costing?

How many companies are wasting more than £50,000 a year on their sales force? This question is raised by Mr. Adam Johnstone the chairman of SALES AUDITS Limited, who believes that the average effectiveness of many sales forces may be around the 60 per cent mark.

From a recent calculation in *The Financial Times* Mr. Johnstone bases his estimates on the probable support cost of salesmen at about £1,920 a year. He accepts that this cost of maintaining a salesman will vary widely according to the company, product and the nature of the sales problem. As an average he thinks it is reasonably close.

This means that a 10 per cent decrease in the effectiveness of a salesman means that about £192 is being wasted each year; or a company with a sales force of 70 working at about 60 per cent effectiveness causes a loss to the company of £53,760.

Although a higher effectiveness than 90 per cent is not thought to be very likely, there are reasons for lower figures that can be identified and remedied.

It may be that the salesman is completely convincing his potential customers but is let down by bad delivery and lack of follow-up from the office. Or the salesman may have a territory too small for his time and energy. He will still be handicapped if the territory is too large so that he cannot properly get around it.

Mr. Johnstone goes on to even more frightening calculations. Falling off in the effectiveness of a sales force will be accompanied by a depressing effect on the success of the rest of the marketing policy, including its advertising and sales promotion. These are all interlinked and a failure in one must affect the others.

Given that the company with a substantial sales force will have a promotional budget well into six figures, it is demonstrable that ineffectiveness on the part of the sales force will be multiplied as much as fourfold in terms of money wasted in the general marketing allocation.

Profits Fall Below Estimate

The news from chairmen of companies whose fortunes are directly tied up with the consumer markets continues to contain unpleasant surprises.

One of the most recent comes from the KENWOOD MANUFACTURING company, who produce kitchen equipment.

Mr. J. H. Senior, the Kenwood chairman, has circularised his shareholders explaining that profits in the months up to 31 July will be a long way below the estimates made known back in December. A decision on the interim dividend has been postponed.

The difficult conditions are not entirely due to the state of the market. Mr. Senior says that the late delivery of a special machine tool which was essential to the production of a new model meant that quantity production was not reached until June.

The new Peerless and Ericsson division of the company was also longer in being brought up to a profitable standard than had been anticipated.

Although the credit restrictions have had a depressing effect on the group's sales at home, Mr. Senior is able to report that during the past three months production and sales were above the levels which had been planned for the spring months.

Viscounts and BEA's Profit

British European Airways' debt to the renowned Viscount aircraft, of which it has 63, is impressive.

Nine-tenths of the corporation's revenue in the last financial year came from Viscount flights. The smooth-flying Viscounts carried 2·6 million passengers during the year, four-fifths of the total of 3·3 million.

The corporation includes among its Viscounts 19 of the more advanced Viscount 806s. The Viscount 806 has a figure of earnings per revenue hour of £289, which gives an excess over cost of £58·2 per hour. The load factor of 69·8 per cent—39 people—was 14 per cent above the figure needed to cover costs. This was done although average flight lengths were only 352 miles.

VICKERS-ARMSTRONGS (AIRCRAFT) Vanguards will be taking over on the routes between London and Edinburgh, Glasgow and Belfast from next spring and to the Continent the Vanguard will be introduced on the London-Paris route.

New Australian Capital Negotiations in New York

The Australian authorities continue to raise fresh money in the world's money centres for the financing of their rapid industrial expansion.

The latest step is the opening in New York of negotiations for a new loan to Australia of $25 million (more than £A7 million). This will be the first overseas loan raised by the Australian government in the new financial year.

Another Firm Contracts Out from State Pensions

The BRITISH MANUFACTURE AND RESEARCH Company, of Grantham, Lincs., the English division of the HISPANO SUIZA concern, has decided to contract out of the proposed government pension scheme. The improved form of the company's own scheme is felt to provide benefits greater than those of the government scheme.

The company's pension arrangements provide for immediate life assurance cover. On retirement it is possible for a quarter of the pension to be taken in a tax-free lump sum, with the company's approval. The scheme includes non-contributory sickness and accident benefits.

Seasonal Fall in Retail Prices Index

Lower prices for vegetables and apples brought about a slight fall in the August index of retail prices.

The official index figure for the month fell to 110·4 from 111·1 in July. The level of average retail prices at mid-January, 1960, is taken as 100.

Self-Induced Relief of Airframe Loads

Linking aileron deflection with wing deflections can reduce the variable aerodynamic wing load imposed by gusts and manoeuvring. This should increase the fatigue life of the wings without adding weight.

WIND tunnel experiments conducted on a method of partially relieving a wing structure of the peaks in the variable aerodynamical loading were described in a paper by Professor F. Misztal of the University of Warsaw. He was speaking at the recent Second Congress of the International Council of the Aeronautical Sciences held in Zurich. His idea is not entirely new, having been tried in this country a few years ago, but it appears to merit further consideration for certain types of application. The principle uses an aileron the angular position of which at any instant is governed by the amount of wing load. In this way fluctuations in aerodynamic wing loading imposed by gusts and manoeuvring can be ironed out to some extent. In a full sized aircraft, of course, there is bound to be a time lag between the wing load sensing and the correcting movement of the aileron.

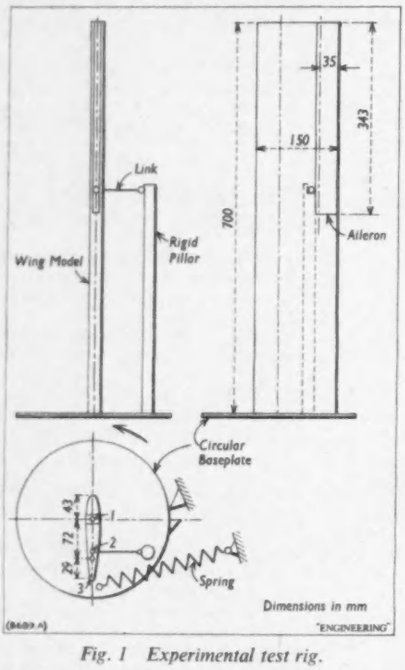


Fig. 1 Experimental test rig.

Fig. 1 shows the wind tunnel test rig used by Professor Misztal. For convenience wing load detection was made by using the wing's elastic properties, the aileron movement depending on the amount of deflection, but in an aircraft this would, of course, be impracticable due to the necessity of the external fixed connection. In Fig. 1 a rectangular half wing model is shown, elastic in bending, with symmetrical NACA 0018 profile, fixed rigidly to a circular baseplate at the end representing the wing root. A single spar wooden structure was used for the wing model. The aileron could be locked in position relative to the wing, or alternatively it could be hinged on it rotationally and connected via a link and a rigid pillar to the common base plate. When linked to the pillar the aileron was deflected proportionally to the bending deflection of the wing under load. The baseplate with the whole assembly could be turned from the symmetrical position of the profile in the flow to about 10° of incidence under the action of a spring. A stop on the plate limited the actual rotation.

The experiments were conducted with a constant air flow velocity of 40 metres per sec (about 130 ft per sec). Displacement of three points 1, 2 and 3 on the wing tip (see Fig. 1) were observed by motion pictures taken at 0·025 sec intervals. Rotation of the wing model during each series of readings varied the incidence, an increasing incidence producing a corresponding increase in aerodynamic loading and bending. Displacement of point 1 indicates wing deflection, while the relative displacements between points 1 and 2, and 2 and 3 give the wing incidence and aileron deflection respectively.

Results

The deflections during a wing rotation (with increasing incidence) were plotted against time under the two conditions, (A) with the aileron locked and (B) with the aileron hinged and linked to the pillar. Fig. 2 shows typical curves in which the reduction in deflection caused by the use of the aileron is clearly evident. The dotted lines represent relatively small oscillations excited by shock at the instant of stopping the rotation.

Fig. 3 shows the relation between the bending deflections and the incidence angle of the wing in the investigated cases, under the two conditions. The relationships are nearly linear and the deflections are reduced to about two-thirds by extending the use of the aileron over the entire investigated incidence region. Lag in aerodynamic response to the wing incidence variation, corresponding to the gust loads in flight, is very small. It can be explained by the play in the aileron linkage, and indicates that the desired effect of wing loading reduction can only be realised in practice, even with small gusts, if a continuous positive coupling arrangement can be assured.

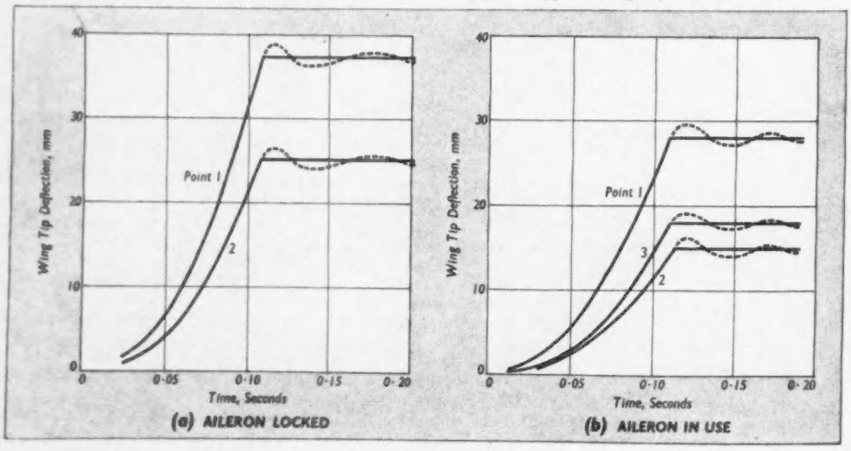


Fig. 2 Typical wing deflection/time curves.

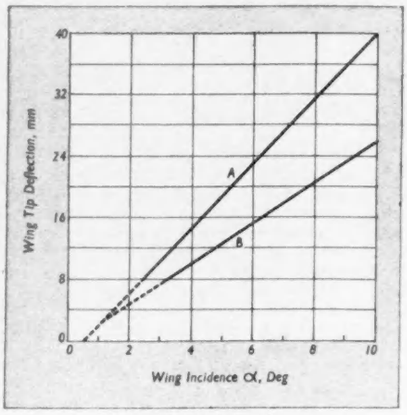


Fig. 3 Wing deflection/incidence curves.

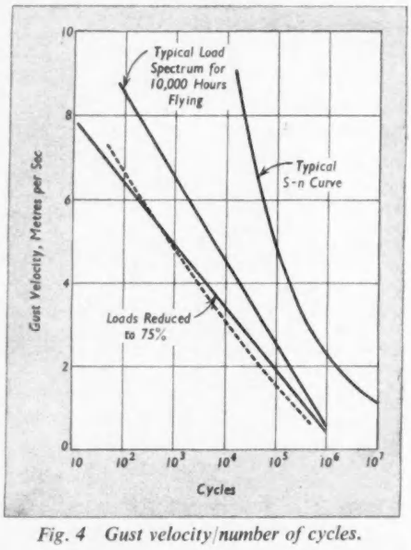


Fig. 4 Gust velocity/number of cycles.

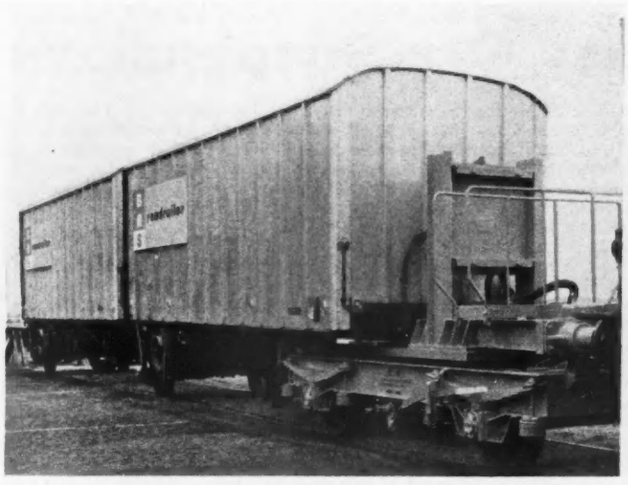
In order to define precisely the influence of air speed and other flight conditions on the load alleviation effect of aileron wing coupling, further investigation is required. However, by making certain simplifying assumptions it has been found that by doubling the flight speed (from 70 to 140 metre per sec), a relief of 25 per cent of the gust loads could rise to 50 per cent.

Fig. 4 shows a typical load spectrum corresponding to 10,000 hours flying, together with a typical *S-n* curve for a wing structure component, a spar for example. From this load diagram curves can be plotted representing the percentage damage to the component during that time. These show that if on the same aircraft an aileron wing deflection coupling is applied to reduce the gust loads to, say, 75 per cent, the fatigue life of the structure would be improved and the fatigue of the component over three times.

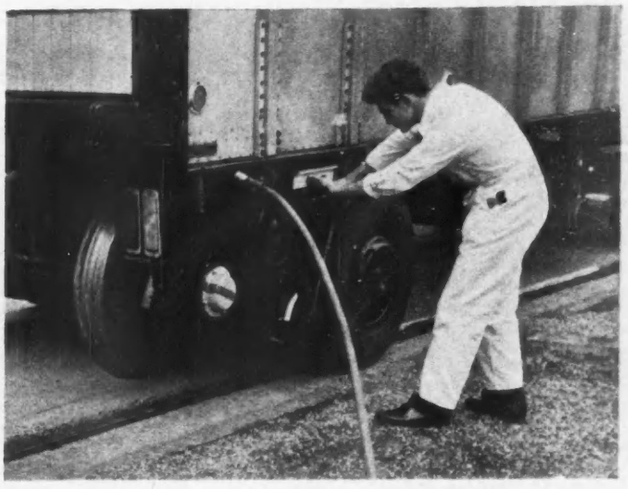
Conclusions

If the practical difficulties previously mentioned could be overcome, this method would reduce considerably the gust and manoeuvring loads and hence the fatigue damage for a given flight time. It would also narrow the band of loads over which most of the damage is done.

However, aileron wing deflection coupling could not be taken into consideration by the designer with a view to making the structure lighter, due to the possibility of damage to the aileron or the necessity of switching off the coupling device under certain flight conditions.



The two prototype Roadrailers and the adapter truck coupled together as a train for railway operation.



The changeover operation takes 90 sec. The compressed air supply line is visible, also one of the transfer legs to the right of the operator.

Today's Approach to Road-Rail Goods Transfer

The Roadrailer recently demonstrated in London foreshadows the form in which fast door-to-door freight movement in this country may soon take. It differs in principle from most other road/rail designs of the past, few of which were technically and economically feasible, by having been conceived as a road vehicle adaptable to run on rails, instead of vice versa.

The left-hand photograph shows the two existing prototype vehicles when on rails. Each is carried by a pair of rail wheels at the rear end, while the front end is supported from the road-railer in front, except in the case of the leading vehicle in the train. The leading vehicle has its front end carried on a special 4 wheel adapter truck, which incorporates all the buffing and drawgear, as well as the vacuum braking equipment. An interesting feature of this truck is its turntable top which allows it to run in either direction—also of course only one such truck is needed per train of roadrailers, which may be as long as 40 vehicles or even more.

When running on the road each Roadrailer forms an articulated semi-trailer in conjunction with any standard form of road tractor. The road and rail wheels on each vehicle are disposed at either end of a rocking lever arrangement, which permits either set to be lowered and locked in position. While changing over, both sets make momentary simultaneous contact with the ground. The transfer mechanism is compressed air operated from an 80 lb per sq. in supply by means of an air motor driving a ball screw actuator. The changeover operation, which is illustrated in the second photograph, takes 90 seconds and, at each railhead where transfer is customary, the services of a small air compressor will be required—or, alternatively, the adapter truck could be modified to carry a compressor. During changeover the front end is supported by two collapsible transfer legs.

Leading particulars of the Roadrailer are as follows:

Dimensions: length 24 ft 7½ in, width 8 ft, height 8 ft 2 in.

Materials: aluminium body fabricated integrally with "Corten" high tensile steel underframe.

Weights: gross 16 tons, payload 11 tons (1,400 cu. ft loading volume).

Design speed: 70 m.p.h.

Suspension: two Torsilastic springs.

Braking: (*a*) rail: vacuum-operated disc on web of wheel; (*b*) road: air-operated standard expanding type.

Couplings: (*a*) rail: truncated ball, plug socket, locking into rear headstock of leading vehicle by retractable pins; (*b*) road: standard king-pin fifth wheel arrangement.

Wheels: (*a*) rail: two of 30 in diameter; (*b*) road: four-in-line with 10·00 × 15 in tyres.

The Roadrailer is currently on show at the Commercial Motor Show at Earls Court and, as such was mentioned in ENGINEERING for 16 Sept. '60, p. 382. It was developed simultaneously by British Railways (Eastern Region and the Chesapeake and Ohio Railway of the USA, and built by the Pressed Steel Company of Cowley, Oxford, at their Paisley works.

Expansion Joints For High Pressure Ducting

One of the characteristic problems in atomic power station design is that of accommodating the thermal expansions of the ducting conveying the coolant gas from the reactor to the heat exchangers. This expansion movement is generally catered for by allowing angularity of one or more legs of the ducting, but this introduces complications, due to the difficulty of designing satisfactory "pin-joints" in the ducting. The operating conditions and the duct sizes are such that the more usual bellows form of expansion joint cannot be used because of the resulting unbalanced end thrust.

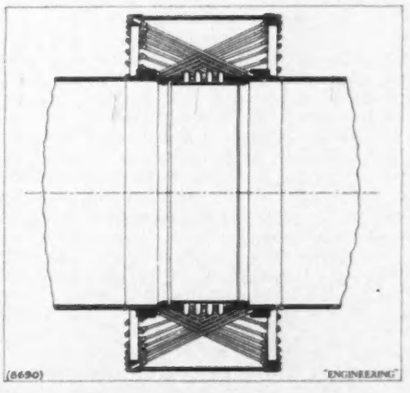
A modified expansion joint is being fitted in the ducting at Trawsfynydd atomic power station, which is claimed to deal satisfactorily with the problem by allowing angularity in any plane without imposing axial thrust. The accompanying diagram shows its configuration. This joint is entirely elastic when deforming angularly, but behaves as a stiff connection in the axial direction.

A conventional bellows type joint is used surrounded by a restraint consisting of a multiplicity of high tensile steel bars, arranged in two groups as frustro-conical assemblies and spaced uniformly around the duct periphery. By interlacing them as shown in the illustration, the overall length is kept to a minimum. The bars allow the joint to deform angularly by bending transversely under familiar elastic laws, and the forces involved are therefore accurately predictable and not variable in time. Also, the complete rotational symmetry of the restraint makes the joint equally flexible in any direction. A wide range of working deflections and restoring moments can be accommodated by varying the basic dimension of the restraint, the number and size of the tie bars, and the cone angle.

A simple centring device connecting the two duct stub ends ensures that no torque loading can be imposed on the joint, and equalises the deflections of the two sets of bars under conditions of sharply changing bending moment along the duct. All the shear is taken by the centring device, thus relieving the bellows joint of all forces except those in bending.

Apart from the bellows convolutions the tension bars are the only components subject to any appreciable stresses, and in addition to the ease of calculations for the bars it is also of obvious benefit to use highest quality steels and stringent manufacturing controls. This is made possible by the large number of bars and by the fact that they are not welded to the duct structure.

The new type of joint has recently been developed by Richardsons Westgarth and Company Limited, Wallsend, Northumberland, one



of the founder members of Atomic Power Construction Limited, who are building the Transfynydd station.

It is claimed that its use saves civil engineering work by simplifying ducting runs, and application of this joint to other types of high pressure and temperature ducting is currently being investigated.

Simulating Ride to Test Car Suspensions

A tape recorder, an anologue computer and a car body carried on hydraulic jacks make up the simulation equipment for assessing the riding charactistics of suspensions, without a road test.

GENERAL Motors Corporation acknowledge that to assess the ride quality of a vehicle suspension you have to have people experiencing the ride. But the firm have speeded up the testing of designs by doing away with the road and the car. Their assessor of ride quality rides in a simulated car over a simulated road. Changes in suspension design are made by re-adjustment of the dial of the simulator. A flick of a switch changes the ride experienced from that of the front seat to that of the back seat. Different road surfaces are selected from a library of magnetic tapes. The speed of the simulated ride depends on how fast the selected road is played.

In an analysis of car behaviour, the vehicle motions can be conveniently divided into ride motions and handling motions. The two sets are largely unconnected and can be studied separately. Consequently a study of ride can be begun by considering only two motions: bouncing and pitching. Yawing, rolling, and side slipping are generally associated with steering control, and are considered as "handling" motions. It turns out, however, that this convenient subdivision is upset in practice by human frailty. The high human sensitivity to roll displacements dictates that rolling motion be incorporated in any complete ride study.

The construction of the General Motors simulator allows a more comprehensive analysis of ride than has hitherto been attempted.

PASSENGER TOLERANCE

In addition to some drawing-board analysis and restricted analogue studies of suspensions, a little work has been done on passenger tolerance to vibration; but not in sufficient detail to be useful to the designer. Also, there were few or no data on the types of irregularities present in various road surfaces. An account of General Motors work is given in "Analysis and Simulation of Automobile Ride," by R. H. Kohr, read before the Society of Automotive Engineers during National Automobile Week, at Detroit.

Three main units can be distinguished in the complete simulator. The tape recorder provides road-wave inputs to an analogue computer. The analogue computer determines what body motion would result if such a road wave were fed into the suspension system it is set up to represent. A body-motion simulator accepts the computer output, and a portion of a standard car body is pitched, bounced, and rolled by electrohydraulic rams controlled by the computer voltages. Two passengers can be accommodated in the motion simulator and the driver controls the "speed" of the car by pressing the brake or accelerator.

The main performance figures of the ride simulator are given in the table. For comparison, the maximum motions measured in an instrumented test car are also given. In fact, the simulator can produce the extremes of real car motion, with the exception of bounce displacement. This is not considered a major drawback, as the 5 in bump the simulator is able to produce represents a violent disturbance to the passengers at almost any road speed. The real point of the equipment is that it will produce the motions experienced by a real car on a real road to a high degree of fidelity. This was confirmed by the similarity of accelerometer readings from inside a real car and inside the simulator when both were driven over a triangular bump at 20 m.p.h.

To overcome the difficulty of lack of data on road profiles, General Motors are exploring the possibility of measuring the vertical accelerations induced in a towed wheel and then integrating twice to obtain the vertical displacement.

Once the road waves have been put on magnetic tape the problem of providing the inputs for the front and rear suspension systems has to be settled. For cars with equal front and rear treads the road input functions for wheels on each side of the car are identical but displaced with respect to each other by the length of the wheelbase. In the simulator a commercial tape transport modified by the addition of two magnetic heads is used. The spacing between the heads represents the car's wheelbase and each head handles two channels of information—one channel represents the road function under the right side of the car, the other, the left. The delay range available is 0·4 to 1·5 sec. Tape speed variation is continuous over the range 4 in per sec to 40 in per sec, corresponding to car speeds between 15 and 150 m.p.h. Pulse code modulation is used.

SEVEN DEGREES OF FREEDOM

The car model simulated in the computer is a seven degree of freedom system. It takes into account the vertical motions of all four wheels plus the bounce, pitch and roll of the body. The general procedure is indicated in Fig. 2. A difference between the road-wave input and the wheel motion acts through the tyre characteristic to produce a tyre force. Motion of the wheel mass results from the difference between tyre force and suspension force. The suspension force is produced by the difference between wheel motion and body motion, acting through the suspension characteristic. Finally, the body motion results from the action of the body force on it. The complete simulation involves the summing of each of the wheel forces and summing the forces and torques on the body.

Equations of motion are solved in the computer by summing the various forces acting on each mass and integrating twice to obtain displacement. Fig. 3 shows the procedure diagrammatically for one end of the car, whose vertical motion has been denoted by X.

The analogue computer employed is a general purpose unit. To solve the problem and provide coordinate transformations, 82 operational amplifiers are required, and as many as 16 function generators may be used. Measurement of 37 car parameters was necessary to complete the equations of motion. The pitching moment of inertia, for example, was measured by swinging a typical car as part of a compound pendulum. Tyre damping was measured by giving the tyre a sharp jab and measuring the time the oscillation took to damp out.

Ride-Simulator Performance Figures

	Bounce	Pitch	Roll
Maximum acceleration	1,150 in per sec²	1,150° per sec²	500° per sec²
Maximum velocity	40 in per sec	40° per sec	240° per sec
Maximum displacement	± 5 in	± 6°	± 10°
Bandwidth ..	5 c/s	5 c/s	4 c/s
Positional accuracy	0·020 in	0·025°	0·10°
Real Car Performance			
Maximum acceleration	230 in per sec²	180° per sec²	395° per sec²
Maximum velocity	30 in per sec	14° per sec	29° per sec
Maximum displacement	6 in	5°	9°

The weight of the car body and frame used for the motion simulator is carried by a hydraulic cylinder placed centrally. Vertical motions at the front and back of the body are provided by electrohydraulic cylinders acting through movable pads carried on rails attached to the frame of the car. The cylinders are located approximately at the centres of percussion in order to prevent the front servo loading the back and vice versa. Roll is provided by a rotary actuator mounted on the rear movable pad. It is carried up and down in pitch so there is no appreciable coupling between pitch, bounce and roll.

As is indicated in Fig. 3, not only displacement, but velocity also is fed from the computer to the motion simulator. What happens in fact is that the displacement voltage is multiplied in the computer by a factor involving the velocity voltage and a time constant, and the resulting voltage is used to drive the servo in the motion simulator. The effect of this procedure is to increase the apparent bandwidth of the servo's frequency response. In addition, the computer will calculate the coordinate transformation required when the centre of gravity of the simulated car does not correspond with the fixed pivot of the motion simulator, and the transformation required to provide the sensations of rear seat ride to passengers occupying the front seats of the simulator.

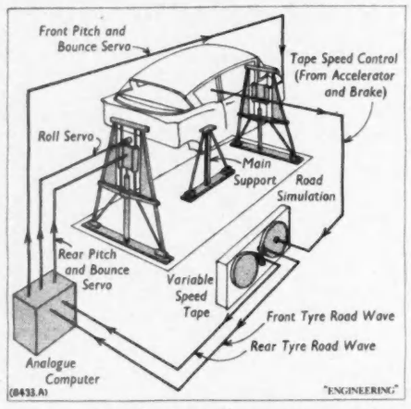


Fig. 1 A small computer transforms the positions of accelerator and brake into signals that will control the speed of the tape simulating the road wave.

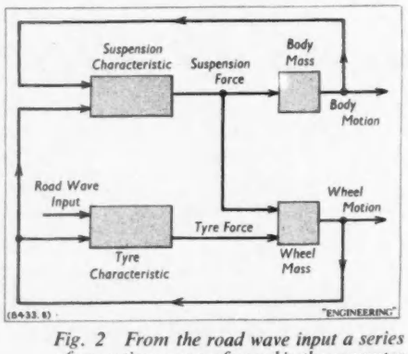


Fig. 2 From the road wave input a series of operations are performed in the computer to derive the body motion. A simplified system for one wheel is shown here.

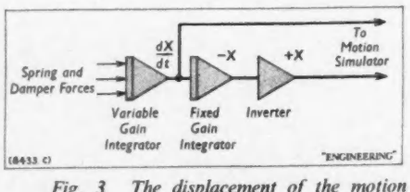


Fig. 3 The displacement of the motion simulator body as a result of the road wave is derived by double intergration. The speed signal is used for bandwidth compensation.

Remote Electrical Power from Isotopes

In recent years much research work has been done on ways and means of converting heat to electricity directly. At the same time, work on radioactive materials has produced a reliable source of heat. The combination of the two methods could be valuable.

REMOTELY located electrical devices must have some reliable source of power for their operation. This has always presented difficulties to the designers of such equipment, since no satisfactory way of storing electricity for long periods has yet been found. In the most remote devices of all—artificial Earth satellites—the problem has been largely overcome by the use of solar radiation cells. However, with devices that never see the light of day, such as submarine telephone cable repeaters, other means of supplying electrical power must be used.

ISOTOPIC POWER

Recent research into the properties of radioisotopes, particularly that carried out at the Martin Nuclear Division in the USA, has indicated that a reliable, self-contained, long-life source of electrical power may now be available.

The general principles underlying this newfound source of power are very simple. Heat is generated when the radiations emitted by a sealed quantity of radio-isotope are absorbed by the isotope and the surrounding container. This steady supply of heat can then be converted into electricity by using any one of several available energy conversion devices. An isotopic power generator, therefore, consists essentially of three components: a radio-isotope fuel, an energy converter and a heat sink (to dissipate excess heat).

There are two main types of radioactive materials that might be used for isotopic power. The first are waste materials arising from the controlled fission of uranium, and the second are alpha-emitting isotopes produced by irradiation of suitable target materials in nuclear reactors. Since the latter class of materials must be manufactured specially, they are inherently more expensive.

There may be two advantages in using fission waste materials: not only would the cost be low but it would assist in the job of disposing of dangerous materials, such as Strontium 90. Strontium 90 has in fact been used experimentally to produce a safe, small power unit with an output capacity of 1,000 watt-years (100W for 10 years).

A number of immediately useful applications have been envisaged for power units of this type, including: remote weather stations; air and sea navigation aids, placed on mountain tops or in the sea; submarine telephone-cable repeaters; and various types of oceanographic research equipment.

RADIATION HAZARDS

In addition to these applications, all of which would require a device for converting heat to electricity directly, there is another useful way of employing isotopic heat. This is to provide the necessary thermal energy to release electrons from the surface of a cathode in a vacuum, or gas-filled valve. Particularly in industrial valves, the cathode filament can consume a very substantial amount of electrical power, simply to obtain thermal energy. Furthermore, since an electrical filament must be well insulated from the cathode, difficulties in manufacture and frequent field failures may arise. Such problems would be non-existent with isotopic cathode heating.

Advantages seldom come without disadvantages, however, and isotopic electrical power is no exception. In fact, it has two distinct drawbacks; both in the form of biological hazards First there is the direct hazard from the penetrating radiation associated with alpha and beta decay, such as X-radiation from *bremsstrahlung*, alpha-neutron reactions and gamma photons from decay products and fuel impurities; and second, there is the potential hazard from the possibility of the radionuclides dispersing into the biosphere with subsequent biological assimilation by humans through inhalation and ingestion. Although each of these hazards is severe, adequate shielding together with stringent safety precautions during construction and operation, could provide a complete answer.

A list of some of the more promising materials is given in Table 1, from which it can be seen that there is a large available range, both in terms of power output density and useful working life.

One of the main power limitations of isotopic generators is the conversion efficiency, i.e., the efficiency with which a device can be made to convert heat into electricity. At the moment, efficiencies of practical converters are low, ranging between 5 and 10 per cent. However, current research, being carried out in several centres throughout the world, shows promise of increasing these efficiencies by a factor of two or more.

CONVERSION SYSTEMS

The three types of direct energy conversion system that are currently being developed are as follow:

Turboelectric System.—The heat generated by a radio-isotope can be converted into electrical energy by a conventional turboelectric Rankine cycle. This can be done at high efficiency when high power is considered. The efficiency drops very rapidly however when the power goes below a few kilowatts. At 5,000 watts thermal input, it is possible to design a 350 watt electrical output system. Since this design uses an extremely high speed turbine, the reliability of such a system falls off with increased power system life. Thus the turboelectric system is best applied to short lived, relatively high power applications.

Thermoelectric System.—Recent advances in the development of thermoelectric semiconductors have enabled isotopic power units to be made with high reliability. The conversion efficiency of such a generator is now in the region of 5 to 6 per cent, and it is confidently anticipated that this may be doubled within a short while. Experimental generators of the thermoelectric type have a power to weight ratio of about one watt per pound.

Thermionic Systems.—When two materials of differing work functions are placed in close proximity *in vacuo* and the high work function material is heated, electrons are released and collected by the low work function material. An electromotive force is thus generated between the two surfaces. The cathode (high work function material) of this device must operate at temperatures above 15,000° F, so that a high isotopic power density is required. Alpha emitters are best suited to such a device. The anode also operates at high temperature to enable high efficiency heat sink techniques to be employed. Thermionic systems can be designed with power/weight ratios of 10 to 15 watts per lb.

TABLE 1:—*Characteristic of Promising Fuel Materials*

Fuel	Probable form	Useful power density (thermal watts per cu. m.)	Half-life
Ce-144	CeO_2	1·96	290 days
Pm-147	Pm_2O_3	1·1	2·6 years
Sr-90	$SrTiO_3$	0·89	28 years
Po-210	Po	90	138 days
Cm-242	CmC	256	165 days
Pu-238	PuC	6·9	90 years

TABLE 2:—*Characterics of "Proof of Principle" Isotopic Generator*

Dimensions	4·75 in diameter, 5·5 in height
Weight	4 lb
Source	1,700 curies (0·38 gram) of Polonium-210
Thermal output	60 watts
Electrical output	3·3 watts to optimum load of 1·7 ohms
Efficiency	5·5 per cent
Total electrical power output over 280 days (approximately 2 half-lives)	10,000 watt-hours
Conventional battery equivalent (over 2 half-lives)	160 lb of zinc-silver cells
Open circuit voltage	5·0 volts
Closed circuit voltage	2·5 volts to 1·7 ohm load
Thermoelectric elements	Lead telluride (P-type doped with bismuth, N-type with sodium)
Hot junction temperature	496° C
Cold junction temperature	107° C
Copper shell temperature	99° C
Dose rate at shell surface	500 milliroentgen per hour
Dose rate at 1 ft	50 milliroentgen per hour
Dose rate at 5 ft	1 milliroentgen per hour

NOTE: Performance data are for unit at beginning of first half-life of Polonium-210 source.

An isotopic electrical generator, shown arrowed, has been envisaged as the power source for a remote weather station. It could operate unattended for two years.

PROOF OF PRINCIPLE

Each of these three conversion systems requires a temperature gradient for its operation. Since only part of the heat generated by the isotope can be converted, it is necessary to dispose of the remaining heat into the surrounding environment. A heat sink is required for this, the design of which would be dependent on the power source used and the environment itself. It is quite feasible to suppose that this waste heat could be put to some use in certain applications.

A "proof of principle" isotopic generator, in which little attempt was made to minimise weight, has been made to work with considerable success (see Table 2). Using a thermoelectric converter technique, this device is considered to be a potentially good proposition for space satellites. It weighs four pounds and has a total electrical power output of 10,000 watt-hours over about 280 days (two half lives of the source material). Its equivalent conventional battery, using zinc silver cells, would weigh somewhere in the region of 160 lb.

Technical Titles Need Careful Translation

By W. D. Arnot, B.Sc.Tech., A.M.I.Mech.E

Two schools of thought prevail among translators, the one taking a timid view, that the translator shall depart little from equivalent or near-equivalent words, and the other, bolder spirits, who contend a translator's duty is to convey the original sense in the idiomatic terms of the language translated into.

If the translator is competent, and has the necessary knowledge of the subject, there is no question that the bolder method is the more proficient, provided no distortion of the original meaning is introduced.

The proviso involves an element of judgment which is the rock on which the contenders split. Let us illustrate the conflict:

Das motorische Verhalten legierter Öle mit unterschiedlicher Alkalität.

The publishers of the journal (*MTZ*) in which this appears render it as:

The engine behaviour of compounded oils of different alkalinity.

But the Englishman says: What is "engine behaviour?" Is it engine-like behaviour or, since it is of oil, behaviour in the engine? Again he says: We compound oils by blending them and we may or may not add improvers other than of hydrocarbon base. But the alkalinity we alter by additives and then refer to the oils as "additive-oils," to distinguish them from simple compounded oils. Further, he says: Oils of different alkalinity pose the question: Different from what? The word he expects is "differing."

Now, the translation is faithful to words, but not to meaning and to that extent is imperfect. The English reader has yet to do his own translation from his native words into his own manner of understanding. Such a title is not one well translated without a knowledge of the treatment in the text. A guess without it would be:

The constitutional stability of additive-oils of differing alkalinity in an operating engine.

But that is not entirely what the author was driving at; the context made it clear that in the English climate of thought his words implied:

The effect on engine condition of additive-oils having differing alkalinity.

It should surely be the translator's duty to convey that meaning, not only for reasons of professional competence but also for the sake of those libraries which will index and classify the text according to its utility.

Taking a further example:

Erweiterte Geräuschmessungen an Kraftfahrzeugen mit einem 4-Kanal-Messschrieber.

The publishing journal (*AT2*) renders it:

Extended noise measurements on vehicles with a four-channel recording meter.

Again the English reader asks what it is that is extended, the noise or the measurements, and what do they extend into or from? Once more a translation without knowledge of the text is something of a guess, and may be rendered:

Augmented vehicle-noise measurements, using a four-channel pen recorder.

Now a survey of the text at once makes it clear that the measurements are recorded in the travelling vehicle although the signals are picked up by microphones attached externally. What the author wished to convey was:

Discrete (or segregated) vehicle-noise measurements made from a moving vehicle using a four-channel pen recorder.

Perhaps the precision of that statement is greater than is contained in the original title; a nearer equivalent unembellished would be:

Discrete vehicle-noise measurements using a four-channel pen recorder. (For pedants, " made with a " for " using.")

And since "discrete" may be confused with "discreet" much the better choice would be:

Segregative vehicle-noise measurements taken with a four-channel pen recorder.

Yet the good translator should surely take the liberty to enhance the title in translation, in such a case.

To point the moral with emphasis, what should be the translation of:

Über die Anwendung der Beschreibungsfunktion zur Prüfung der Stabilität von Abtast-Regelungen. (Regelungstechnik.)

Here the text is imperative for anything but a wild guess. It does explain what the Beschreibungsfunktion is, but even that helps little for if it is not known what the topic is, you may choose between:

Abtastung (Impulstechnik)—sampling (data sampling); (Fernschreiben)—sensing, exploring; (Fernsehen)—scanning,

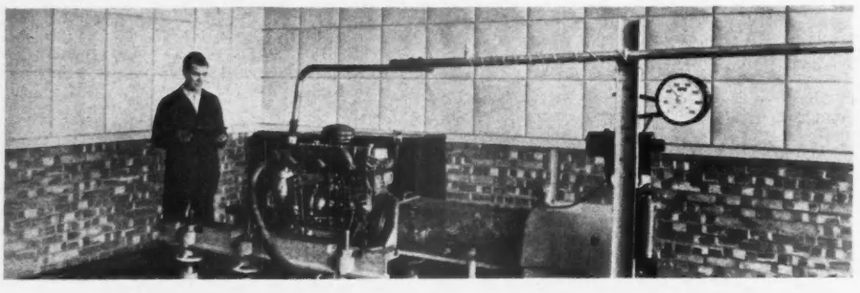
and who is to say which it is? Each requires control.

But what, I wonder, would UNESCO say, or the international documentation authorities, concerning the ethics, copyright and such questions disregarded here in favour of technological utility.

Successful Noise Reduction in Workshops

All major engine overhauls for its fleet of 1,200 commercial vehicles are carried out by Hall and Company Limited in their workshops at Salfords, Surrey. This work uses noisy machines including two large dynamometers.

To reduce this noise level Hall and Company have lined the ceiling and walls of the testing bay with Bowaters Metal Thermal/Acoustic panels. Not only has this experiment in noise reduction proved highly successful from the standpoint of the test bay staff but, by preventing leakage of noise from this section into other workshops and offices, the all-round benefits have been found to be well worth the outlay.



Gas for Explosive Metal-Forming and Welding

An experimental electrolytic gas cell, which generates an oxygen-hydrogen mixture, has shown promise as a fuel source for explosive metal forming operations and high temperature welding and cutting torches.

According to a report issued by the Battelle Memorial Institute, Ohio, USA, the generator consists of a number of flat nickel-plated steel electrodes placed 0·060 in apart in a plastic container holding caustic solution. Current is run into the two outside electrodes with the intermediate ones functioning as bi-polar electrodes. Voltage between the electrodes averages 2v. The volume of gas that is generated can be increased by the addition of further electrodes.

An oxy-hydrogen mixture of appoximately 8 : 1 by weight produces the highest flame temperature, fastest detonation, and greatest increase in pressure when ignited. The estimated cost of producing the gas (in America) is 8 to 24 pence per 100 cu. ft, depending on the cost of power.

When exploded, the gas mixture creates pressure ten times greater than the starting pressure, which is limited only by the strength of the container. For example, a 1,500 lb per sq. in mixture on a 2,000 sq. in working surface would produce a peak explosive force of 15,000 tons when ingnited. Possible applications of this include forming large sheet parts of the type used in the aircraft industry.

Using gas for explosive forming operations may provide some advantages over conventional methods. When solid or liquid explosives are used, pressure of millions of pounds per square inch form the metal within a few microseconds. Shock waves are reflected and reinforce the next wave, sometimes doubling the impact and causing the workpiece to crack.

In contrast to this, gas explosions produce pressures up to hundreds of thousands of pounds per square inch, lasting several milliseconds and having a different shock pattern. With solid explosives, the shock reaches a high level almost instantly, remaining there for a few microseconds and then dropping abruptly. The shock wave of gas explosions rises to a peak within several milliseconds and then tapers off gradually.

Referring to the safety of the device, the Battelle report points out that the autoignition temperature of the gas is about 1,100° F. Also, since the gas is generated only as needed, shipping and storing problems are eliminated.

Used in welding and cutting torches, the burning gases can produce temperatures above 3,600° F: hot enough to cut and weld steels, aluminium, and nickel; melt platinum; and fuse alumina. The flame temperature can be controlled by varying the amount of moisture in the gases. Trace amounts of caustic in the gas mixture create a yellow flame, making it visible and thus easier to control.

High Conversion Efficiency from New Thermoelectric Alloy

Studies being carried out at the Bell Telephone Laboratories, USA, on one of the most efficient thermoelectric materials yet developed were discussed recently at the International Conference on Semiconductors at Prague, Czechoslovakia. The compound is composed of the elements silver, antimony and tellurium. Its chemical designation is silver antimony telluride ($AgSbTe_2$).

Thermoelectric devices presently being considered by industry are based on a principle discovered over a century ago. This discovery showed that when two dissimilar metals were joined together in a circuit, a current could be produced by heating one junction, while the opposite end was maintained at a relatively lower temperature. The reverse of the effect was also found; if a current was passed through the pair, one junction became hotter and the other cooler, depending on the direction of current flow. The effects in metals are quite small, but with the accelerated study of semiconductors following the invention of the transistor, much more efficient materials have been found.

Extensive development work is now being carried out on practical devices such as heat-to-power converters and localised coolers, especially for miniature electronic devices. Although inadequate for many proposed applications, the materials most widely used in present-day thermoelectric devices are lead telluride and bismuth telluride. The search for improved materials at Bell Laboratories has been centered on ternary intermetallic semiconductor compounds, many of which have a cubic crystal structure similar to sodium chloride. The desired crystal formation is somewhat disordered and contains heavy atoms such as tellurium. Many compounds, and alloys of compounds, some with as many as seven elements, have been produced and studied. The best of these discovered to date has been silver antimony telluride. This material is now being widely studied in various laboratories around the world.

Synthesis of these alloys involves the direct fusion of stoichiometric quantities of the desired elements. Zone refining is then used to produce pure samples.

The material possesses a very low thermal conductivity, necessary in order to maintain a temperature differential between two ends of a device. Its thermoelectric figure of merit, "Z," has recently been measured by research workers at the laboratories of the Radio Corporation of America, and is reported to be about $1{\cdot}75 \times 10^{-3}$ per °C over a range of 200° to 500° C, which is the best yet observed for p-type thermoelements in this range.

In the studies reported at the Prague conference silver antimony telluride was described as having a disordered cubic structure, exhibiting a thermal conductivity as low as 0·0064 watt per cm °C at room temperature, only one one-hundredth that of germanium. While the material is always thermoelectrically p-type, its Hall effect is p-type in some specimens, and n-type in others, even when taken from a single ingot.

This anomolous behaviour has been attributed to the presence of a small amount of a second phase consisting of silver telluride, which is swept to one end by zone refining. This n-type compound appears to dominate the room temperature Hall coefficient at concentrations as low as 10 to 20 per cent, while the p-type silver antimony telluride dominates the thermoelectric properties. Further studies of these anomalies are in progress and are expected to advance considerably the knowledge of semiconductors in general.

Measurements of the Hall coefficient are now being made at the Bell Telephone Laboratories, USA, on one of the most efficient thermoelectric materials yet discovered.

Among the objectives of these investigations is the realisation of the optimum properties of this potentially useful material. In particular, the metallurgical problems of producing single phase materials and controlling carrier concentration are of primary importance.

Portable Power Unit Uses Fuel Cells

A portable power supply representing one of the first practical applications of fuel cells—devices that convert chemical energy directly to electricity—is being developed by US General Electric and is currently undergoing evaluation testing.

Although prototype fuel cells of various types have been built in the past, the present GE programme is the first aimed at mass production of a fuel cell power source.

The unit, now being developed for the United States Marine Corps and Army Signal Corps, will supply power for a portable field radar set, and has the ruggedness and dependability of standard military equipment.

The power pack which weighs 30 lb and can be carried by one man, will be capable of producing 200 watts of 24 volt direct current for 14 hours, an output that otherwise would require a 55 lb engine generator or 80 lb of secondary batteries. For continuous operation over longer periods of time, only additional quantities of fuel are required. Thus, full power could be provided for a week at a remote site with only 72 lb of fuel, as opposed to the almost half a ton of freshly-charged batteries that would have to be transported to the site if conventional equipment were used.

The heart of the unit is a series of 30 ion-membrane fuel cells, each consisting of an 11 in square assembly approximately ¼ in thick.

An individual cell consumes only oxygen from the air and hydrogen produced by the decomposition of a metal hydride "fuel"; it has no moving parts and is silent and odourless. It operates at negligible internal pressure and temperature, requires no complex control system and utilises a solid electrolyte rather than a caustic liquid. When large banks of cells or modules are packaged together, a small fan is often used to improve air circulation within the system.

The power pack, which is designed to operate at full load under all weather conditions for a minimum of 2,000 hours without maintenance, can be refuelled with no interruption in operation. The metal hydride is contained in reusable, hermetically sealed canisters which are "plugged" into the pack. Each canister contains approximately 6 lb of fuel, enough to keep the unit going for 14 hours at full load.

World-Wide Progress Report on Computers

A progress report on electronic computers—whose progress over the past 15 years has taken them out of the era of the abacus and into a stage where they rival the human brain—has just been published by the United Nations Educational, Scientific and Cultural Organisation.

The report consists of the complete proceedings of the world's first International Conference on Information Processing. It represents a complete picture of the state of research in information processing. As the report shows, machines can now control other machines, predict the weather, memorise knowledge, compose music, translate languages, and solve in a few minutes problems which may take human beings a lifetime to work out.

Today, it is said, the equivalent of the human memory could be embodied on a piece of glass measuring 5 by 6 in. The electronic circuits representing this "memory" can be stencilled on the glass by special metal deposition techniques.

At the Paris conference, Dr. E. Teller of the University of California, claimed that machines could also be taught to acquire experience, form judgments, develop emotions and take initiative. "I believe that the machine can be given the power to make valuable judgments as well as logical reasoning and from that I can construct, mathematically, a model for machine emotion," said Dr. Teller.

Alarming enough to the layman, this prospect has also caused some concern to the experts. Mr. B. Benson, an American designer and manufacturer, warned that the machine has only as much integrity and honesty as the information fed into it by human beings.

The topics covered by the conference, and recorded in its proceedings, were: methods of digital computing, common symbolic language for computers, automatic translation of languages (particularly technical translations), pattern recognition and machine learning, logical design of computers, and a discussion of future computer techniques.

Considerable attention was given to machine translation of languages and it came to light that computers, supplied with a dictionary on punched tape, can already produce passable translations of scientific papers. Paradoxically enough, these computers which offer a hope of lowering language barriers, are confronted with a Babel of their own. One of the problems that was discussed by the conference at great length was that of finding a "common language" for computers.

Choosing Central Heating

ACCORDING to a survey carried out at the beginning of this year, only about seven families in every hundred have central heating in their houses. Coal fires are used in the living rooms of 73 per cent (57 per cent in the south and 90 per cent in the north) and electric fires in 50 per cent of the bedrooms. But the position is changing, for in the past five years there has been a six-fold increase in the number of homes using oil-fired equipment and the present trend is enlarging this figure.

With the increasing interest in the subject and the widespread ignorance of present equipment, the recent publication of "Central Heating in your Home" by the Institution of Heating and Ventilating Engineers should find wide popularity.* The book gives an objective comparison of the various methods of heating and systems available with, what is perhaps the most interesting feature to the intending user, a set of comparative costs for both installation and running using coal, coke, oil and gas. Full details are given for four houses and a bungalow, with two, three, four and five bedrooms.

What may come as a surprise to many people is the comparatively low cost of running a central heating installation. A system rated at 30,000 Btu per hour, large enough to give full heating for a two bedroom house or background heating for a three bedroom house or bungalow, can be run for less than £50 per annum, which is only 100 cigarettes a week. The capital cost of the same size installation ranges from £245 for a warm air furnace fired by gas to £460 for a complete warm air system fired by oil. So that direct comparison can be made, the room areas for all the houses considered are given and also their heating requirements for both full and background demands.

The second part of the book, rather more than half the 142 pages, contains a list of experienced contractors who are members of the Association of Heating, Ventilating and Domestic Engineering Employers, and a classified list of equipment, (some 80 pages) under such headings as Boilers, Controls, and Systems. It shows what a very wide choice there now is to suit all types of house.

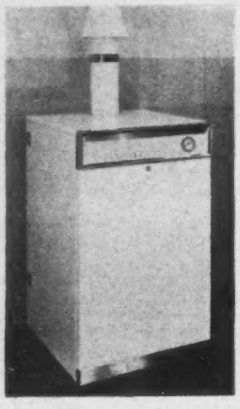
A quotation taken from the first chapter of the book summarises its purposes. "The aim of this book is to show you the possible ways of central heating your house and to tell you about their advantages and disadvantages and the costs of installing and running them, so that you will be able to decide what you want and what you may expect in the way of comfort and convenience for the amount of money you are prepared to spend. But it is not intended to tell you how to design your own central heating system without professional advice."

One of the biggest changes in central heating systems, and one that has taken place almost entirely since the war, is the extent to which aesthetic considerations have been taken into account in the design of equipment. Mention of some new radiator designs has already been made in these pages (ENGNG., p. 72, 8 July '60). Since then it has been found possible to blend the radiator even more into the room by painting it, or by covering with wall paper. An example of the latter method applied to a Wilson "Straightline" radiator (it is only ½ in thick) is shown in one illustration; a contrasting paper has been used to give the effect of a panel. Concealment is made even more complete by fitting the radiator in a vertical position in the alcove. Practical experience over a heating season has shown no sign of peeling, bubbling or discolouration, and the addition of the paper has reduced the efficiency by only about four per cent.

The idea obviously offers many design possibilitities. In one of the other bedrooms of the same house, a papered radiator has been mounted more conventionally below the bow window, again using a contrasting paper. In the dining room the radiators were papered at the same time as the walls and with the same paper; they now blend almost invisibly, but do not offer the effects obtainable by using colour and pattern contrast.

The modern boiler, too, has undergone the same aesthetic treatment with the result that it is both more pleasant to look at as well as more efficient than the old piece of iron, covered with coal or coke dust, of days gone by. Whether fired by coal, oil or gas, the later designs of boiler are not out of place in the cleanest kitchen and are made in both outward size and shape to match the standard kitchen units now available. The one illustrated actually burns oil; the same totally enclosed style is used for gas and coal burners also. The latter include models with a hopper for automatic firing as well as simpler types for hand stoking. But with both forms it is emphasised that there is no dust flying about.

Both for really efficient running and for comfort, central heating systems should be fitted with automatic controls. Although oil and gas lend themselves slightly more easily to this, it can also be applied to coal and coke firing. Using an external thermostat as well as an internal one a degree of "anticipation" can be obtained and the internal heating regulated to correspond to external changes. Apart from controls for the whole system, thermostatic valves are now available for fitting to individual radiators, allowing different temperatures in each room.



(*Left*) *Appearance as well as efficiency has been considered in the modern central heating boiler; this is the Easifire by Rubery Owen.*

(*Right*) *Radiators can be made to appear as panels in a room as with this example of a Wilson "Straightline," mounted vertically and covered with wallpaper.*

* "Central Heating in your Home" published for the Institution of Heating and Ventilating Engineers by Batiste Publications, Ltd., 5*s*.

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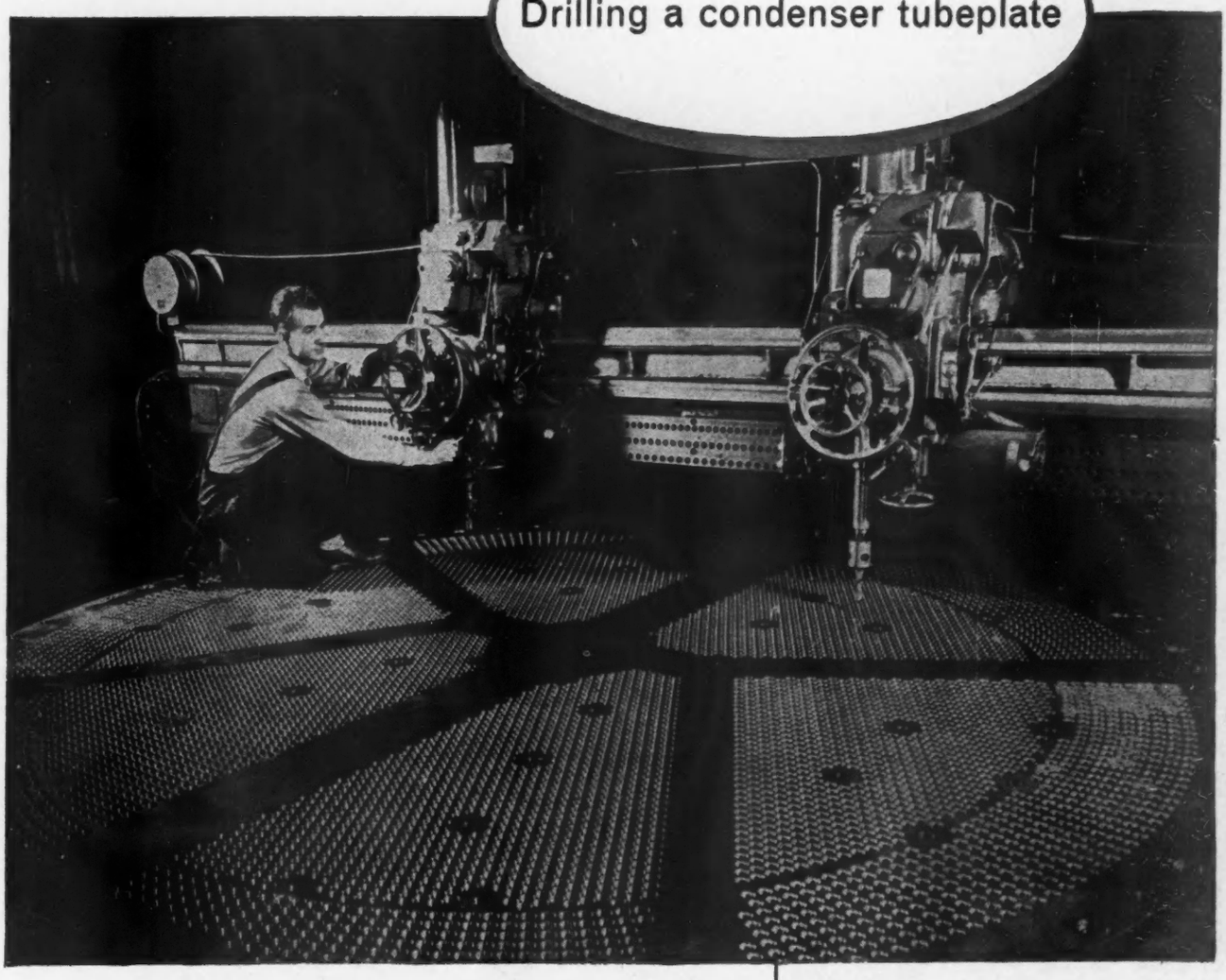

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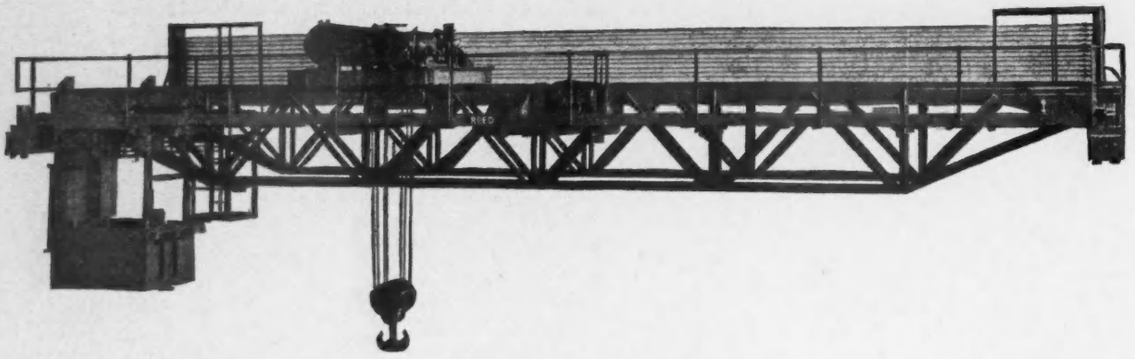

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The new Murex " Fastex 100 " electrode has been specially developed for the rapid vertical downward welding of pipelines by the " stovepipe " method. An extremely fast deposition rate can be obtained by using a " touch " or short-arc technique and the electrode provides a very steady arc over a wide range of current values.

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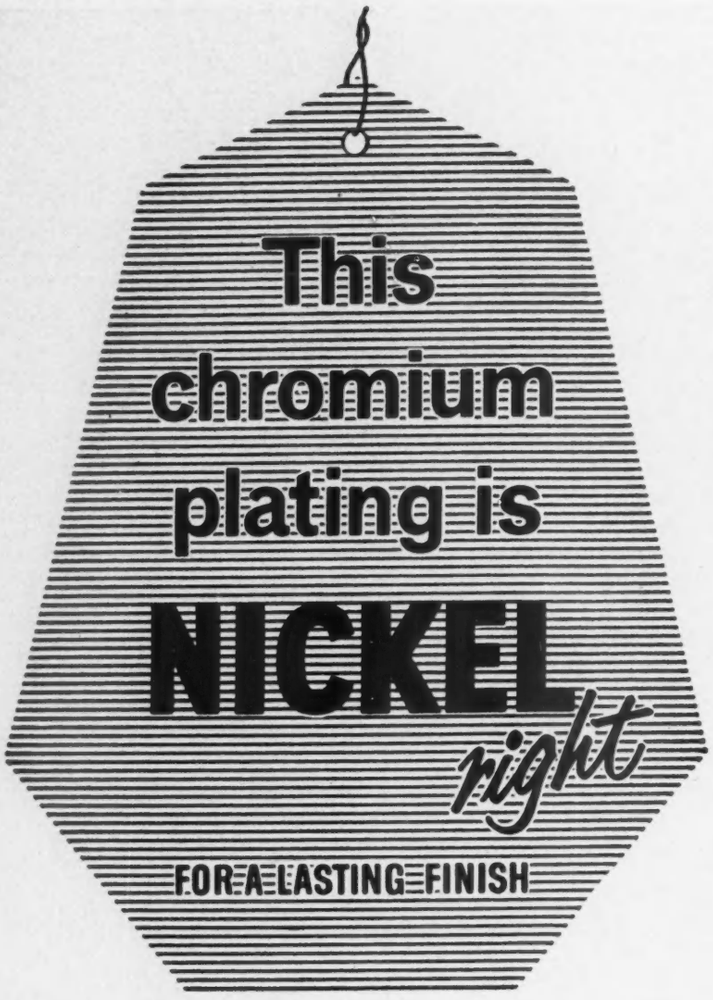

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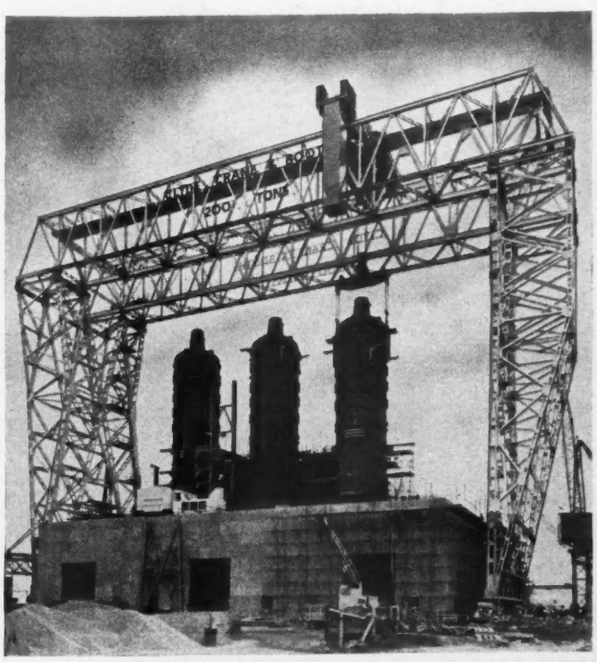

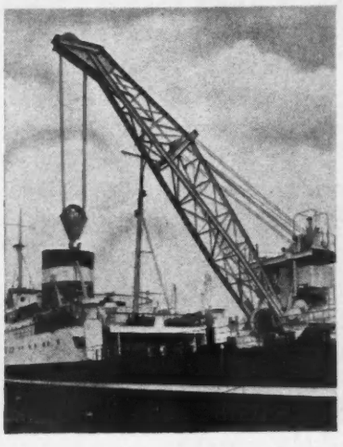

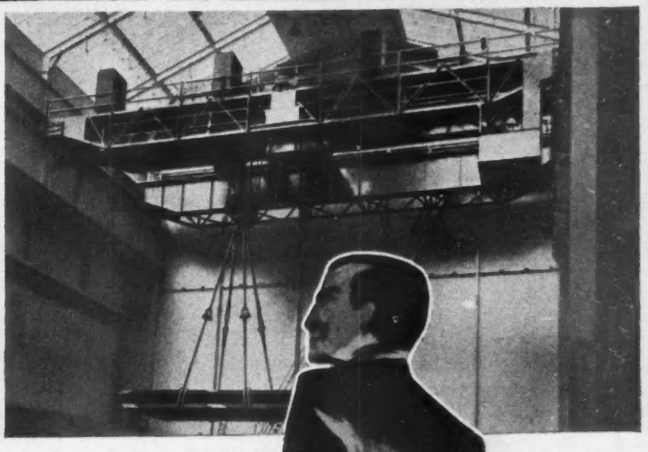

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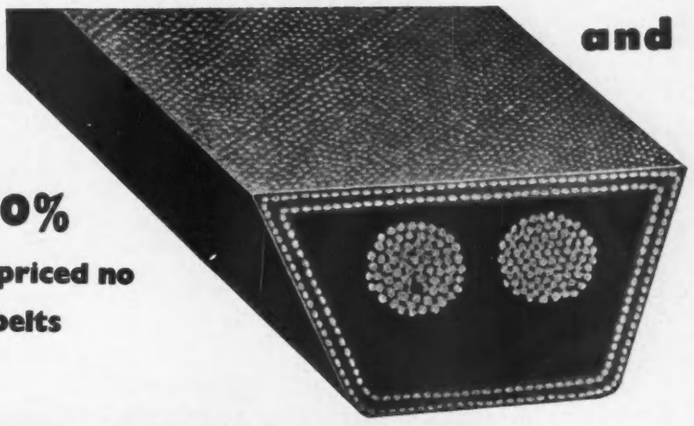
between this  and any other V-belt

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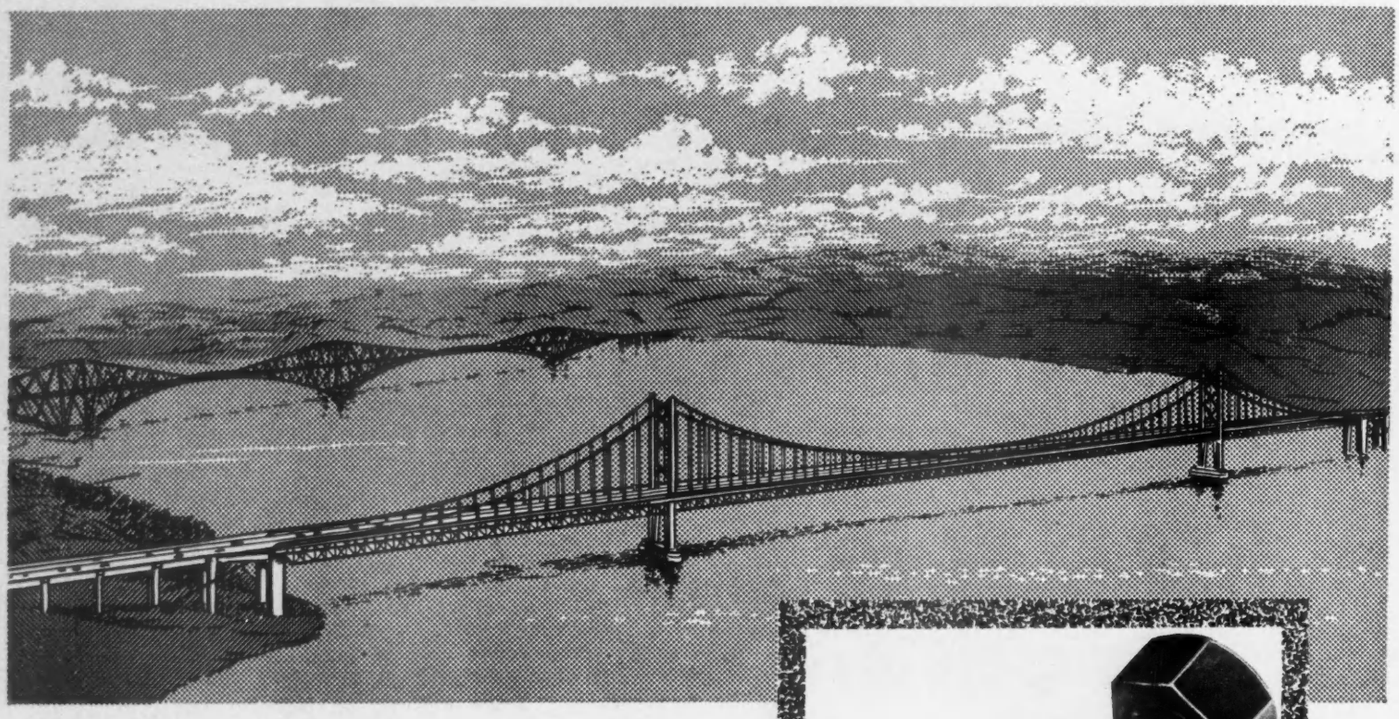

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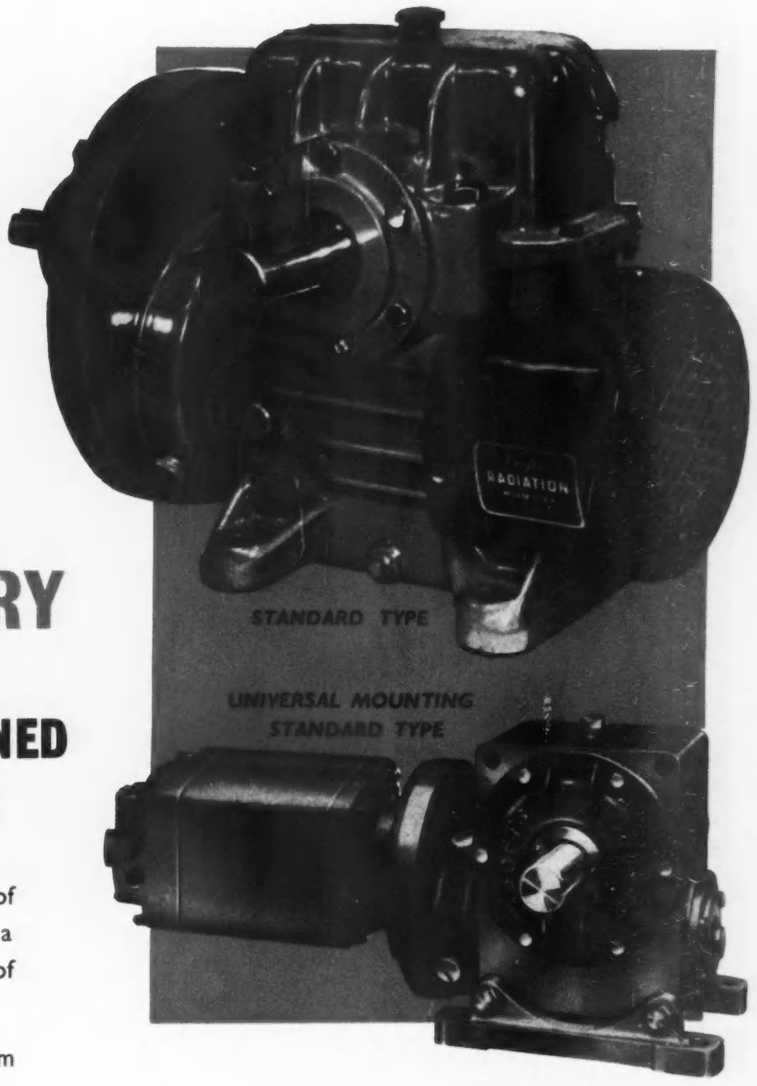

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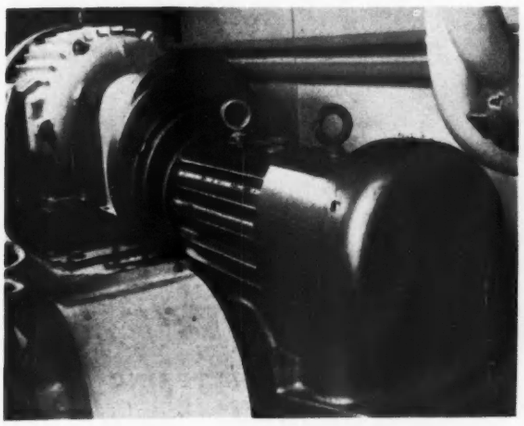

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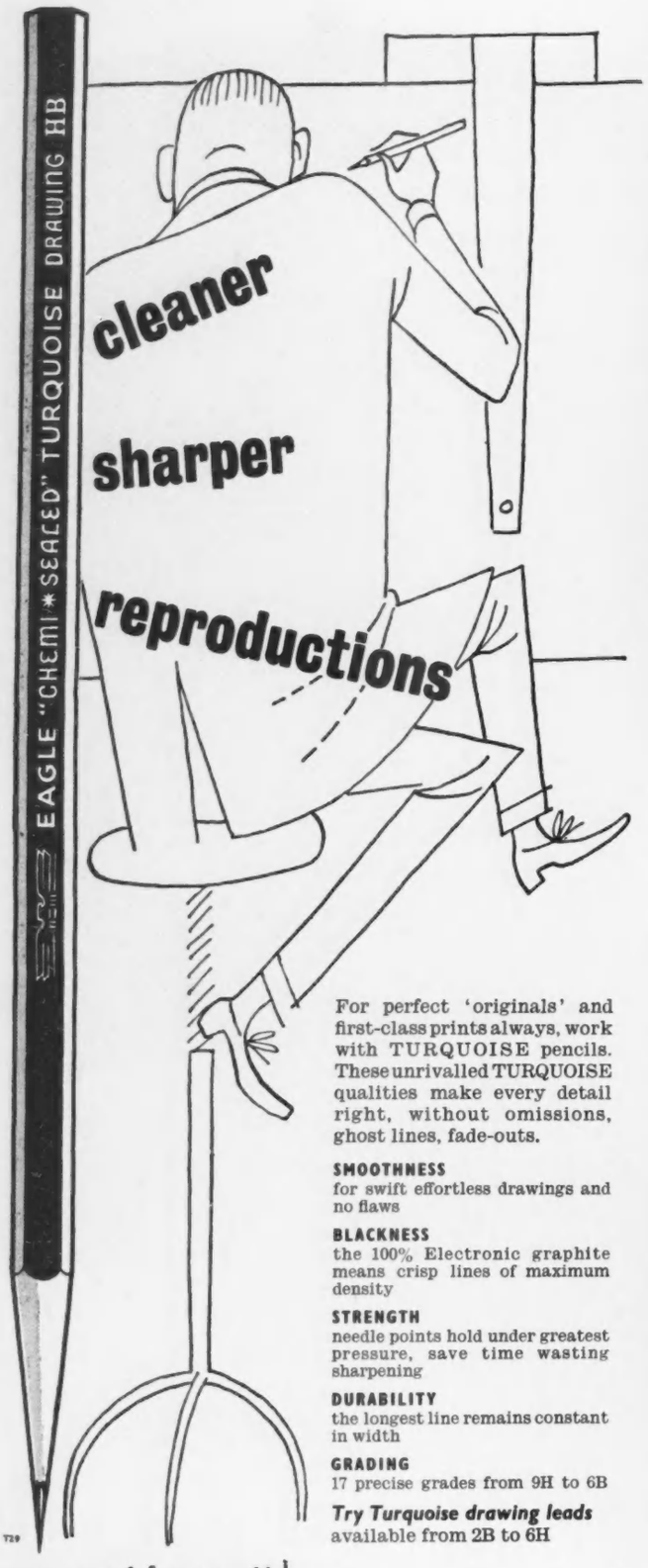

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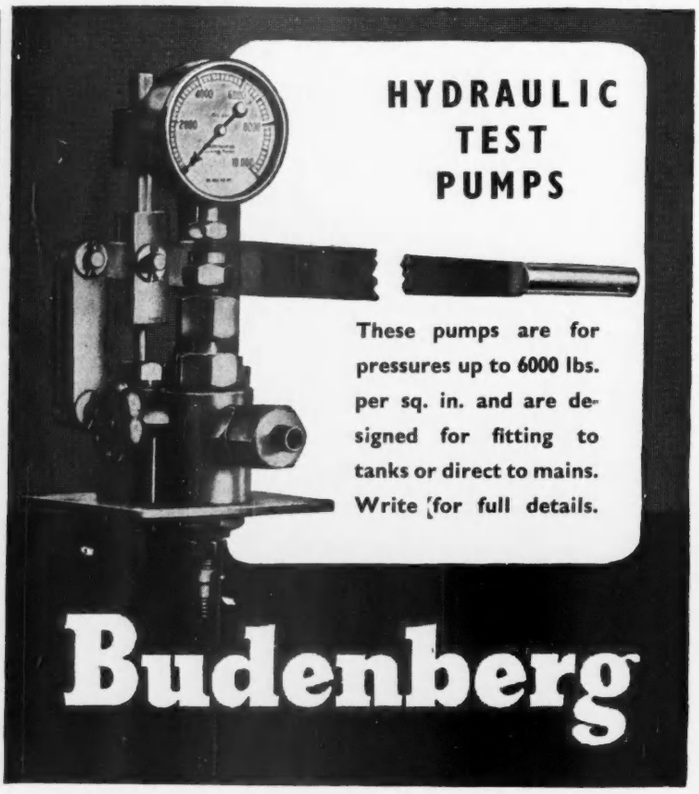

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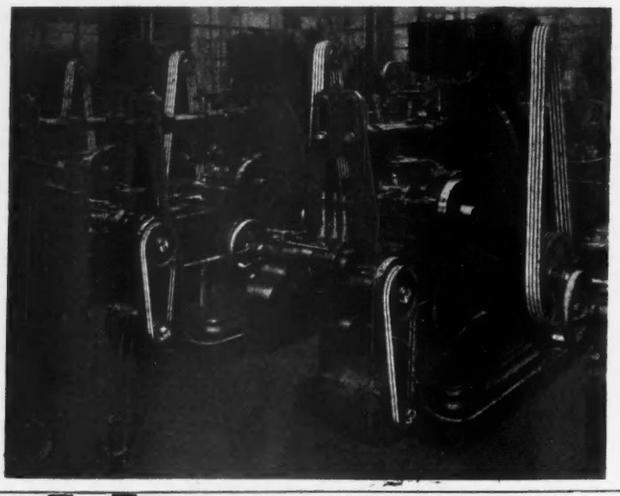

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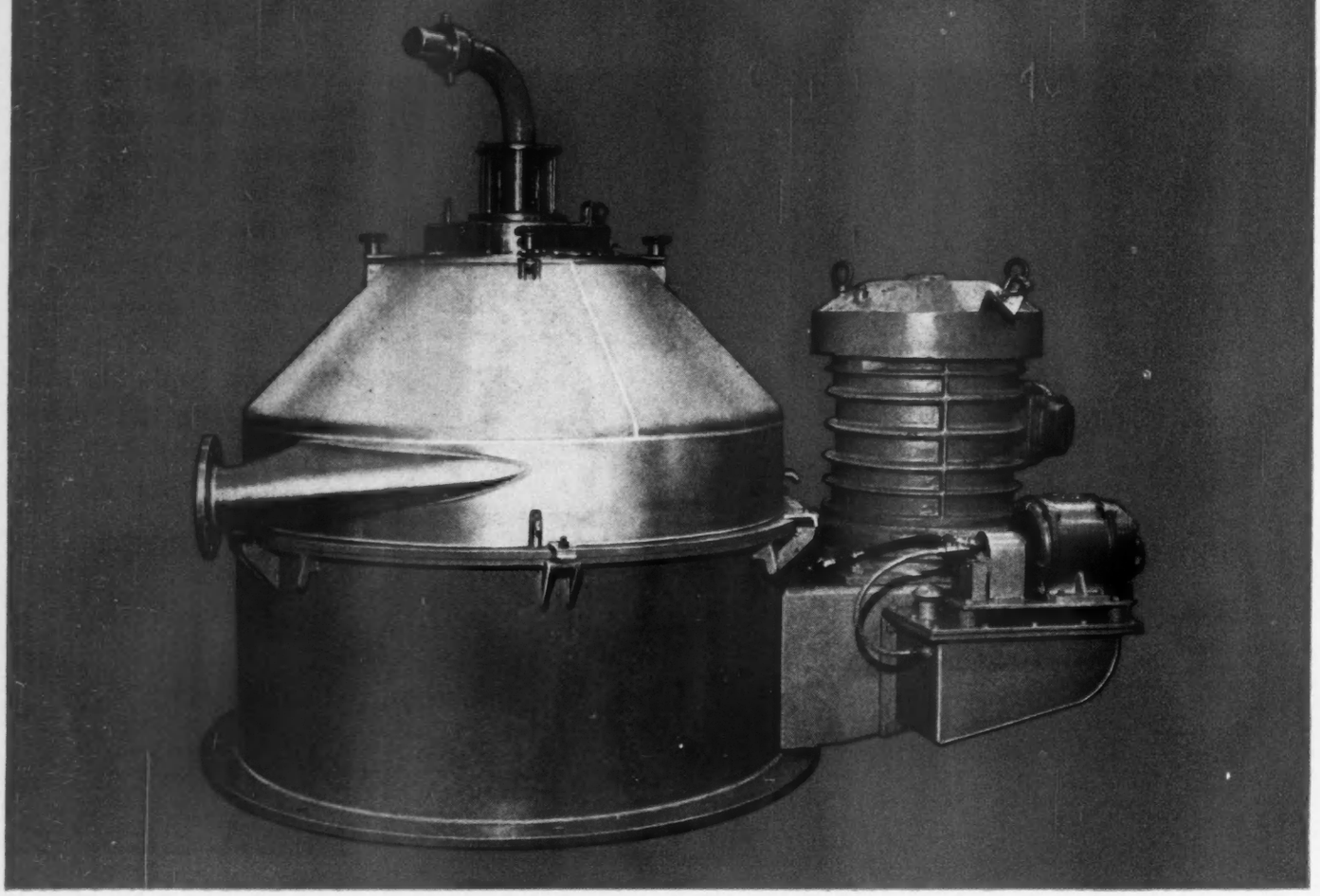

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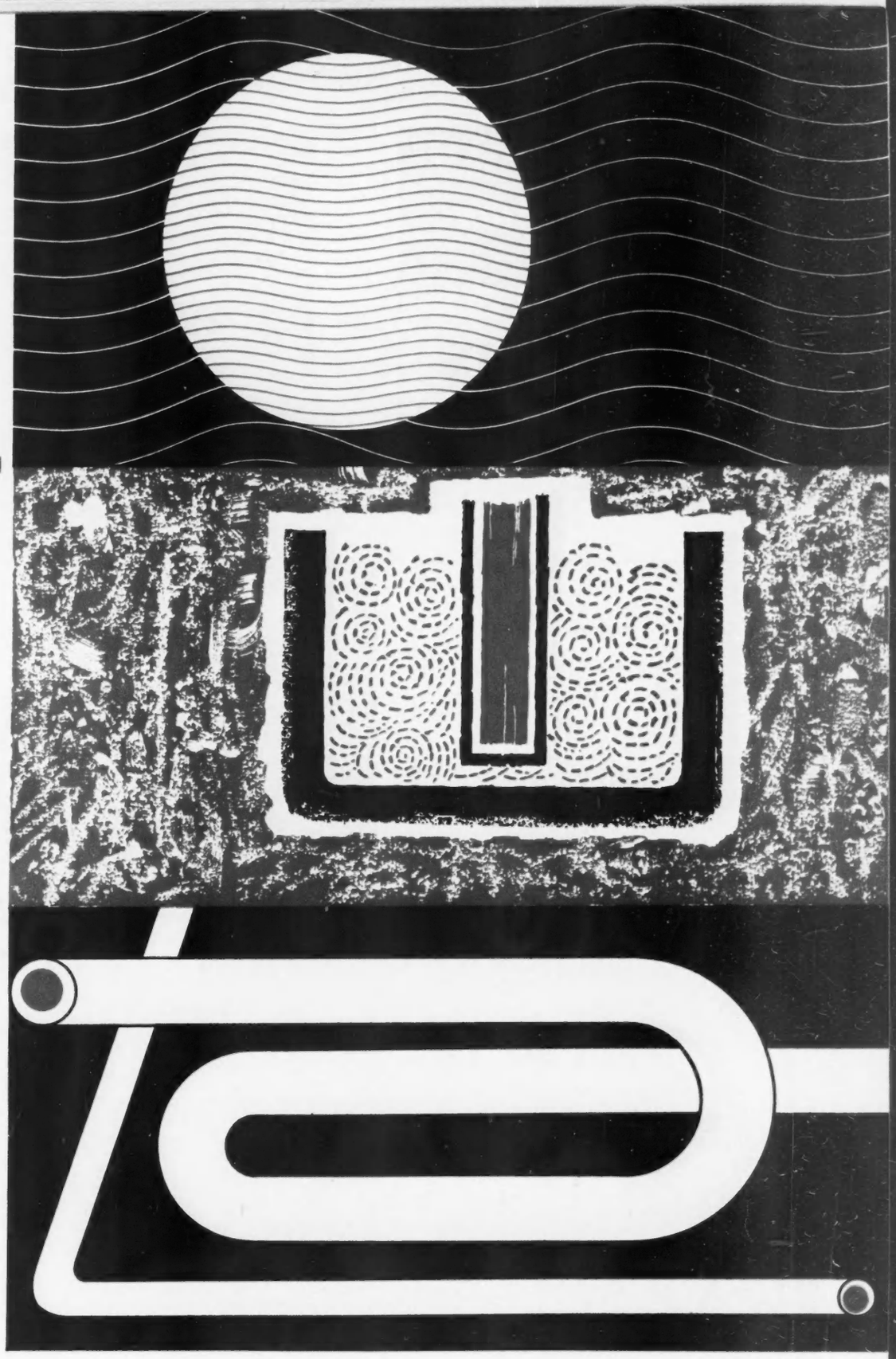

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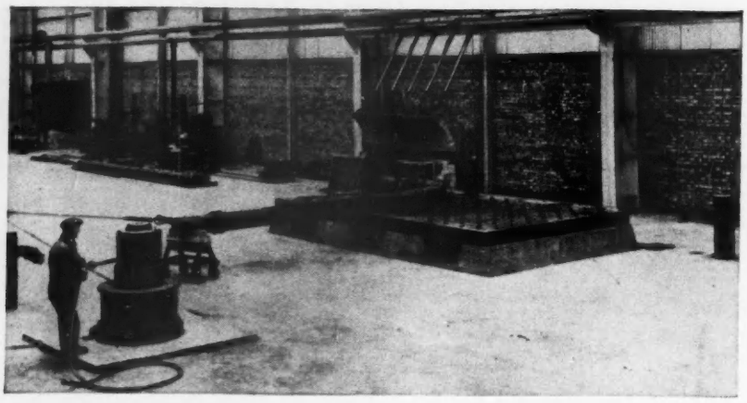

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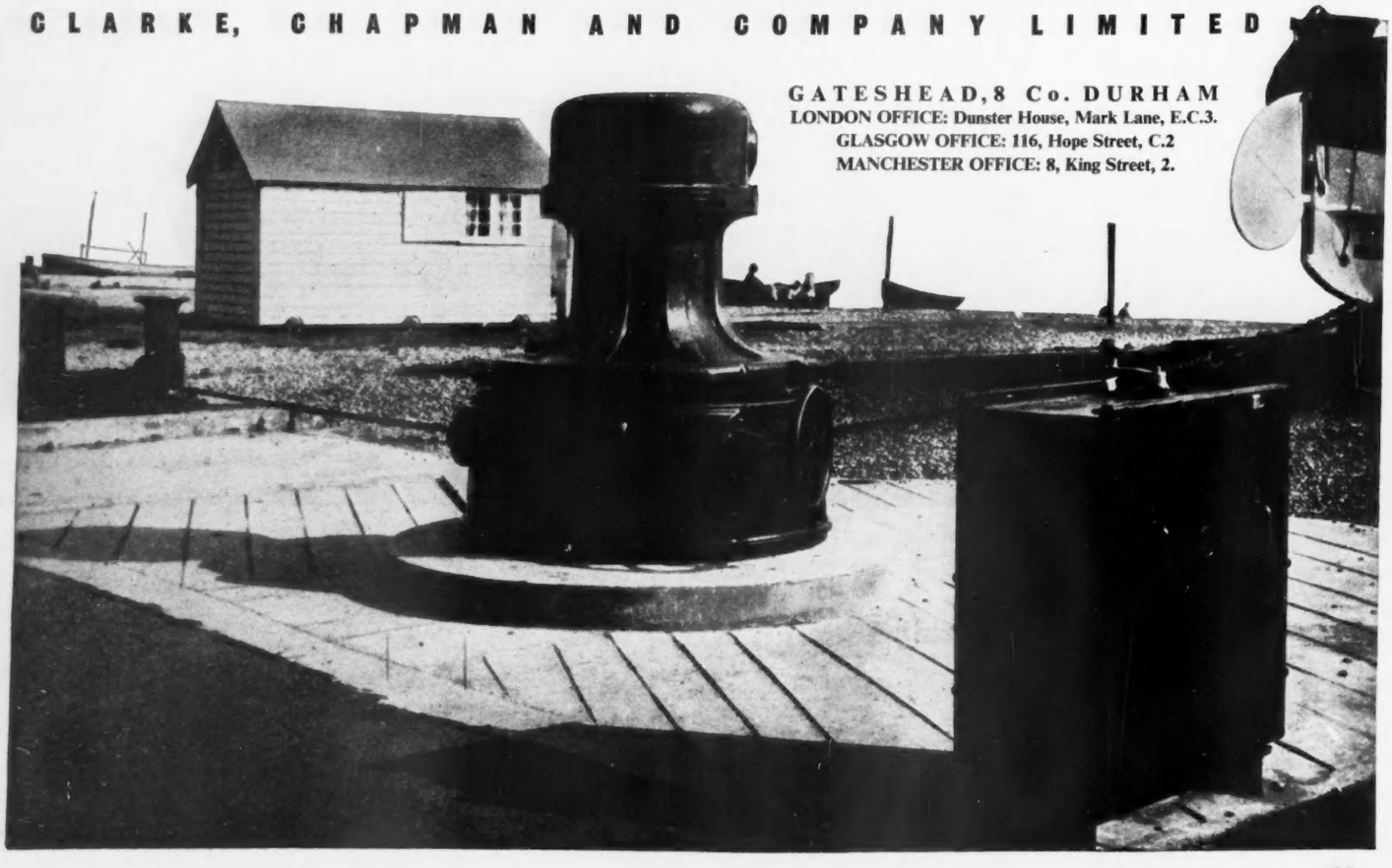

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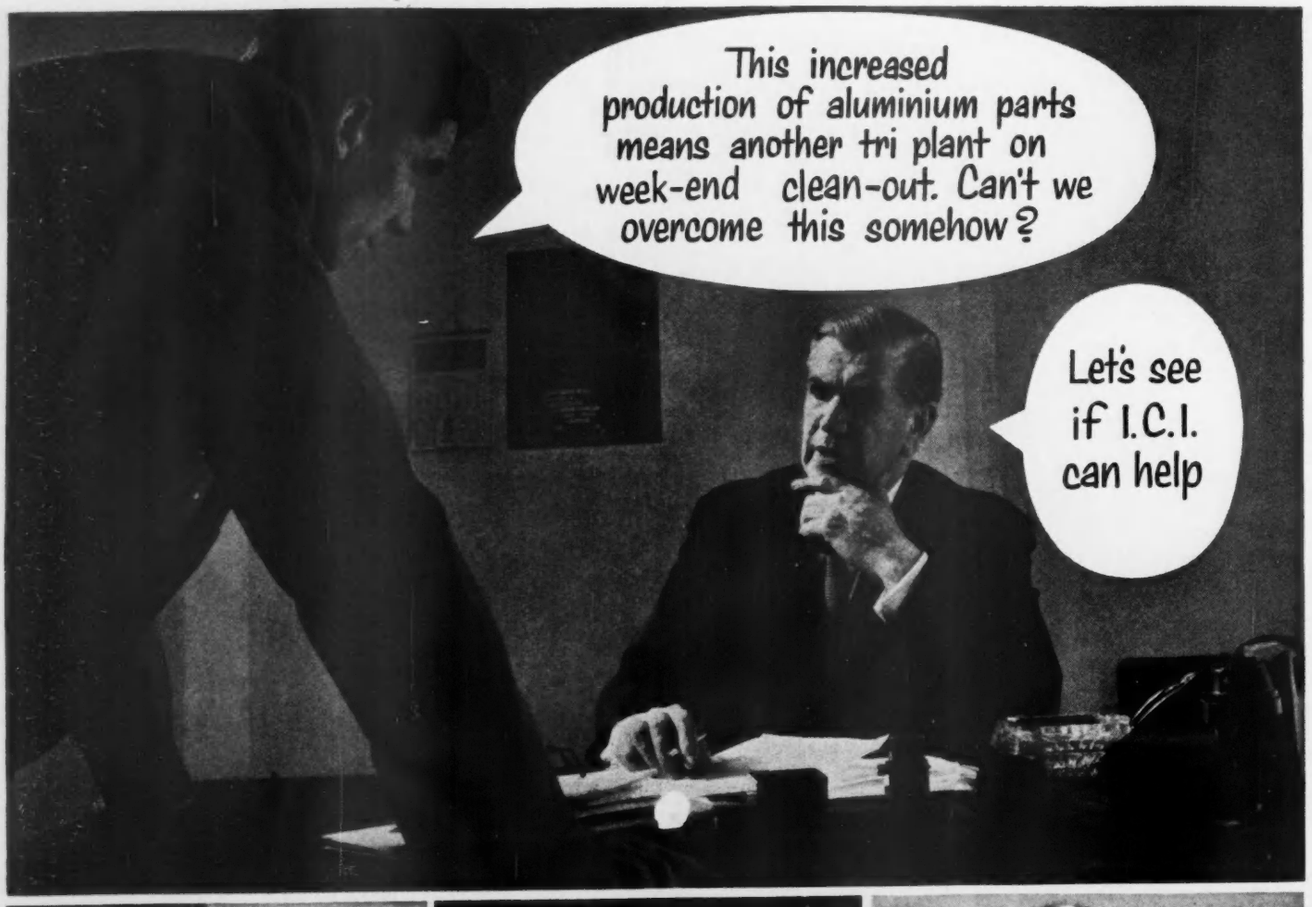
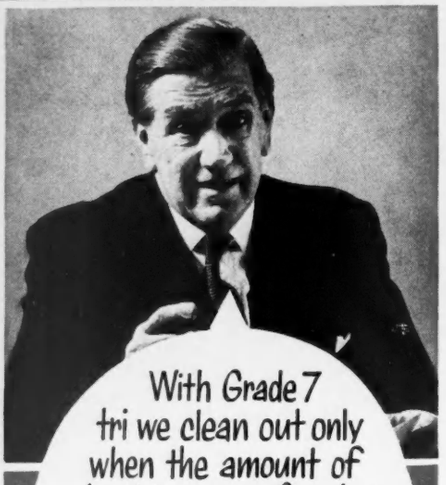

This increased production of aluminium parts means another tri plant on week-end clean-out. Can't we overcome this somehow?
Let's see if I.C.I. can help



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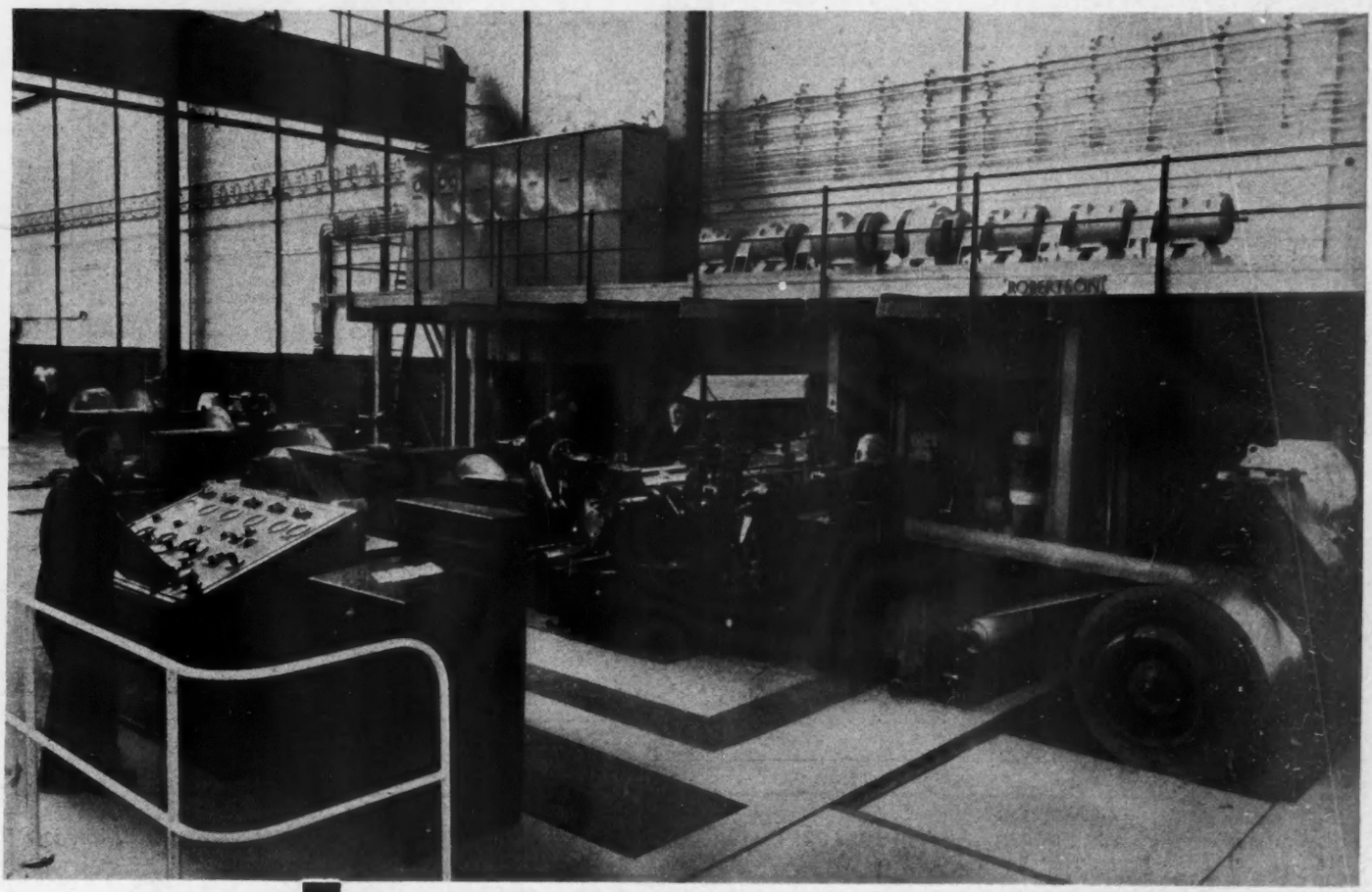

Photograph by courtesy of Firth-Vickers Stainless Steels Ltd.

Stainless steel strip is de-coiled from the drum on the right and passes through the slitter to one, two, three, or four re-coiling drums. Other drums handle the inter-leaving paper. The operations are controlled from the desk on the left.

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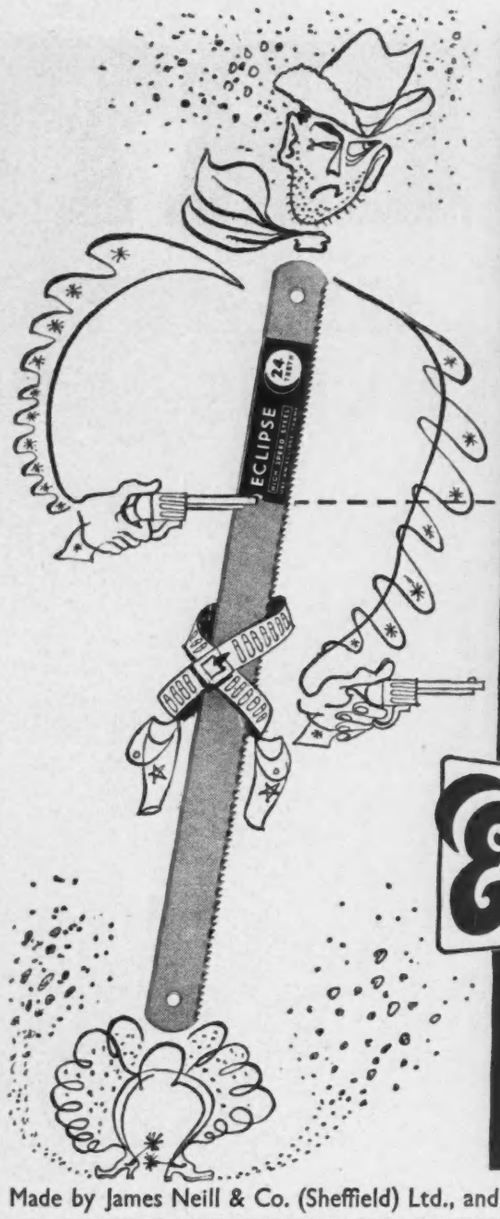

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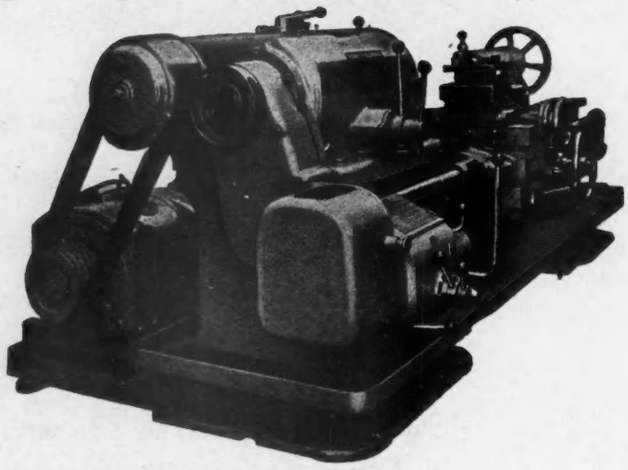

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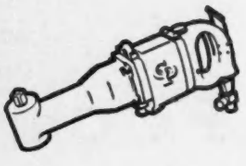

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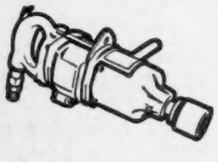

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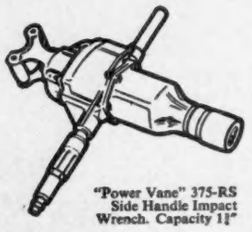

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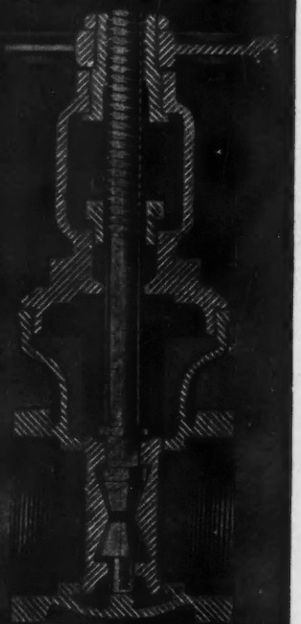

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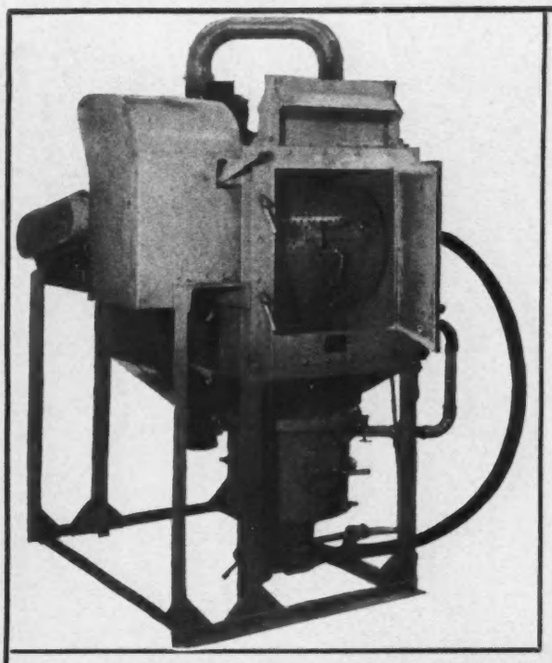

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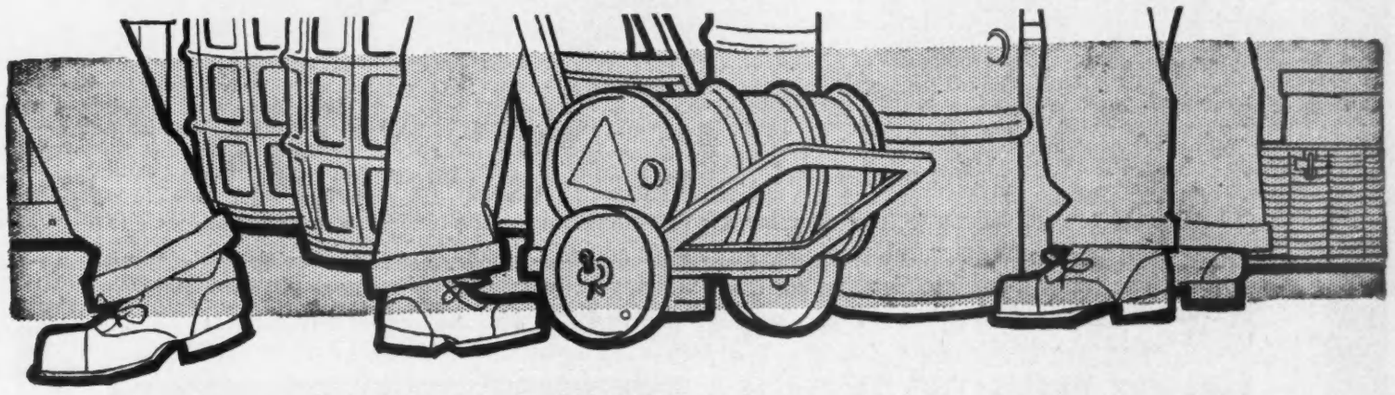

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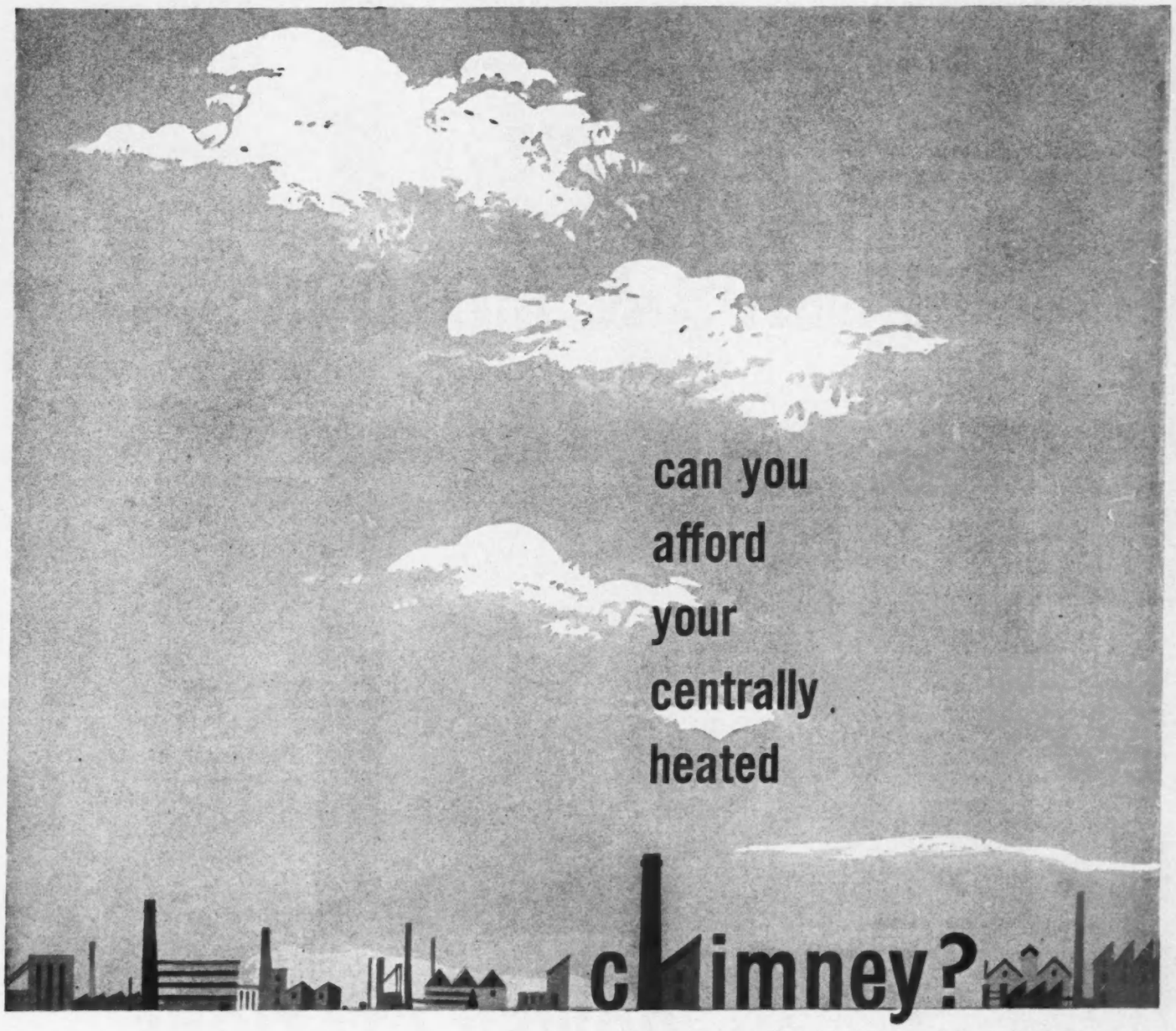

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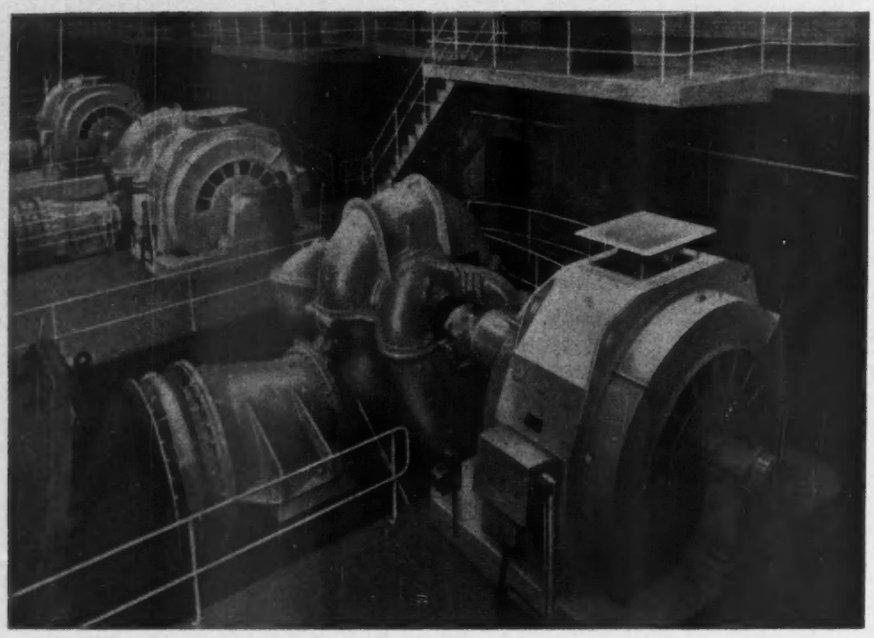

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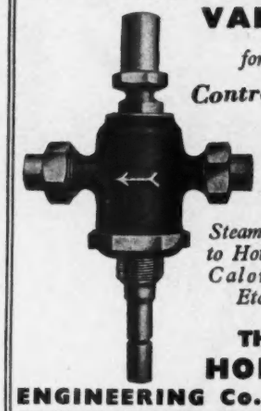

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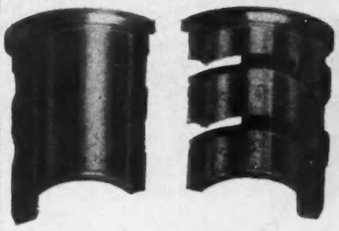

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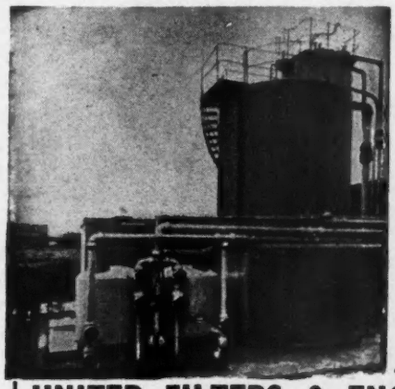

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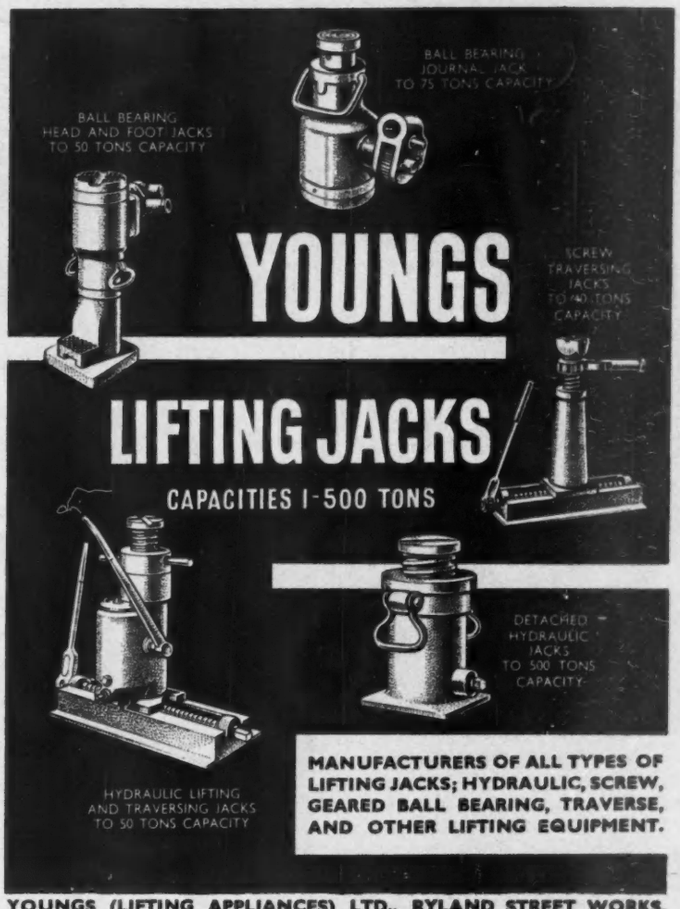
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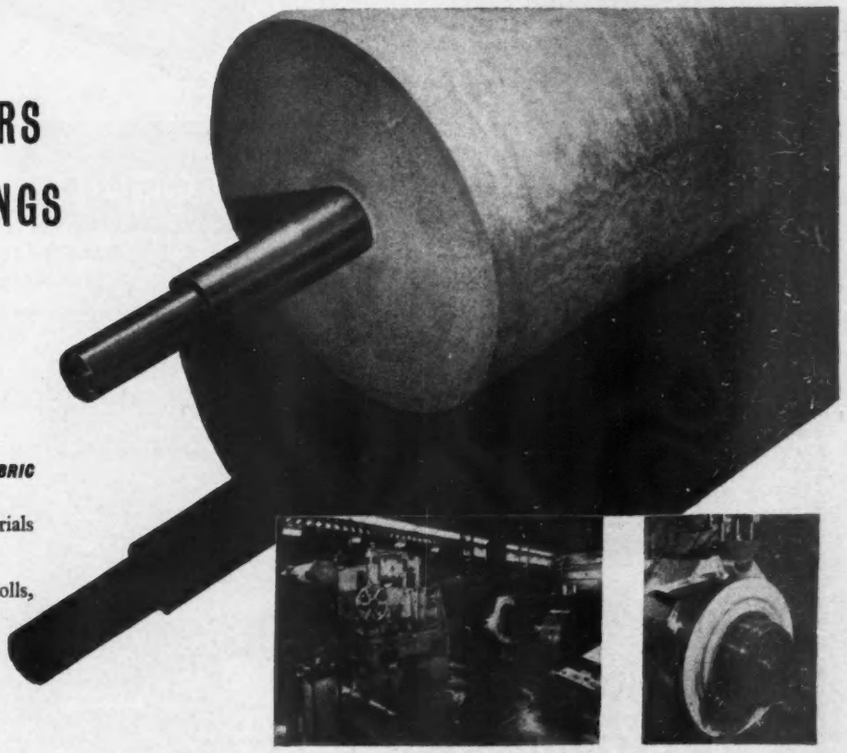

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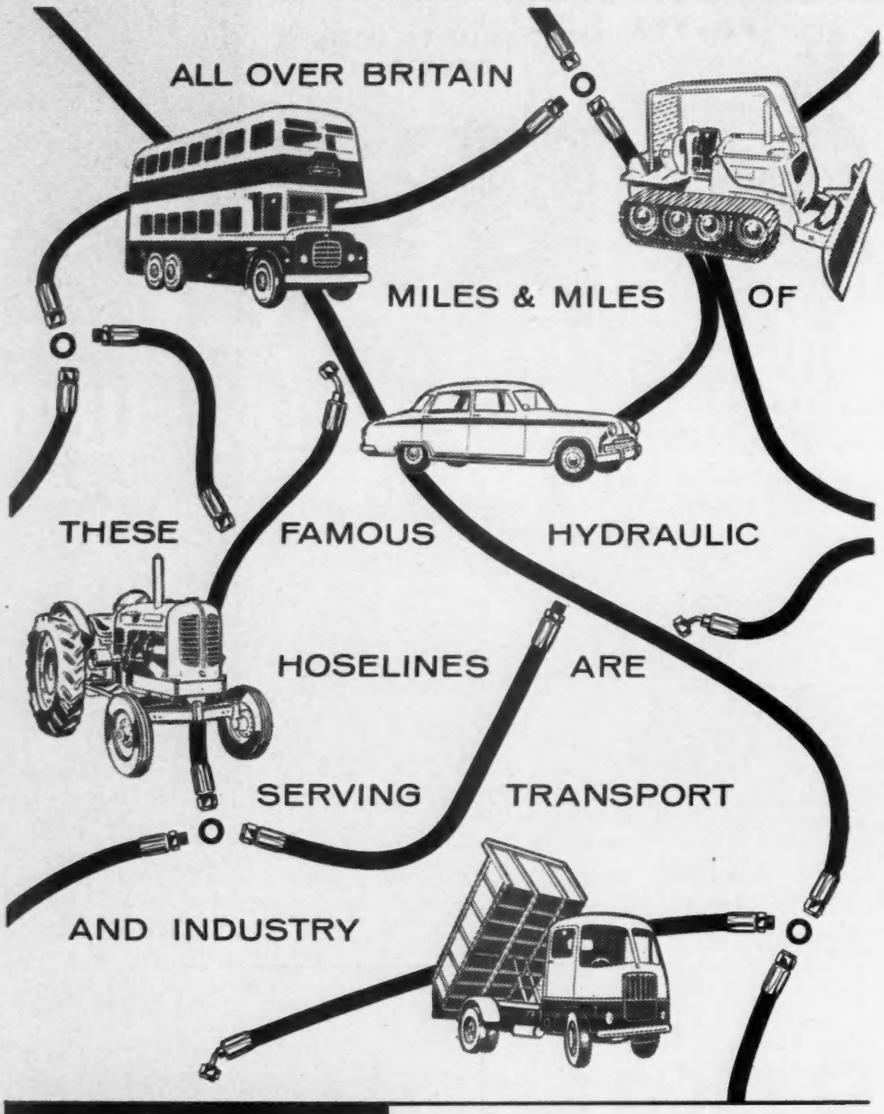

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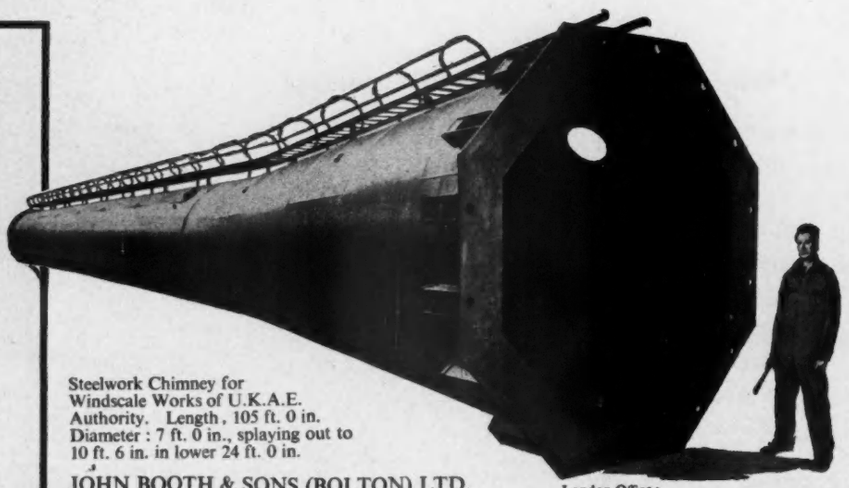

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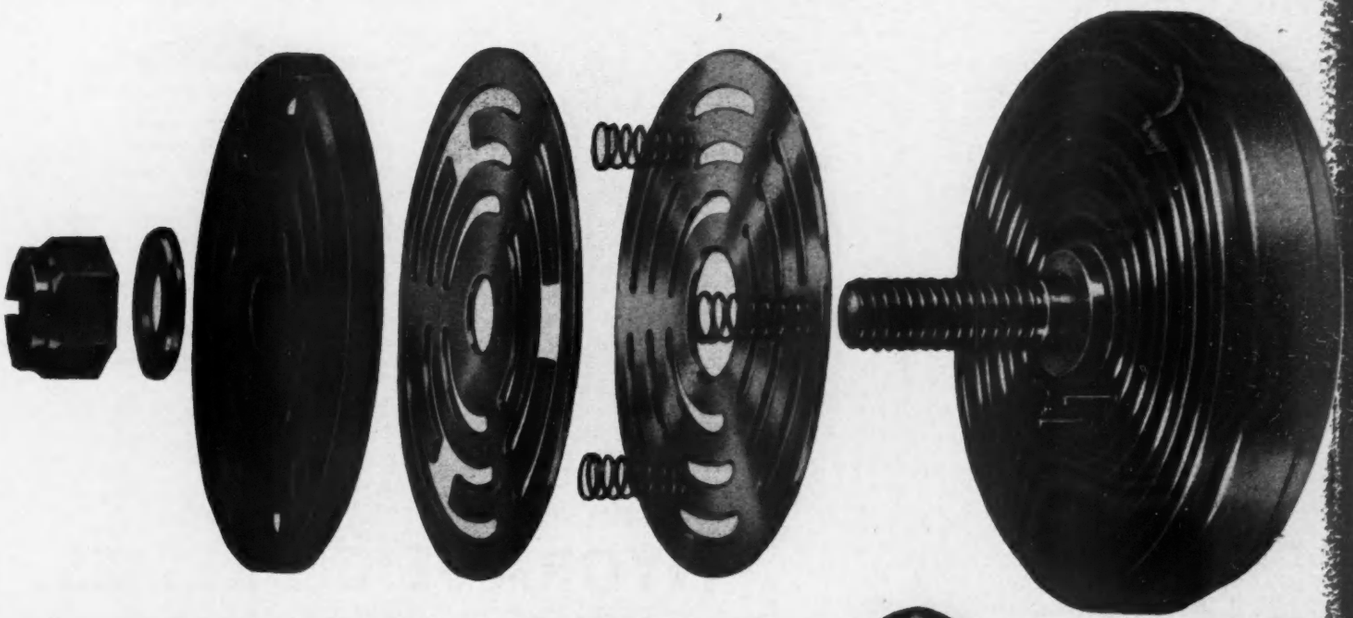

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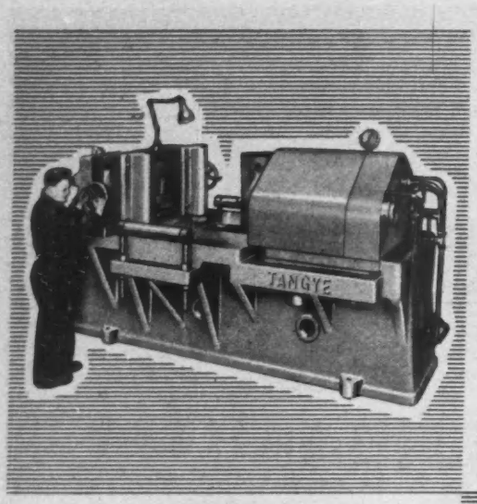

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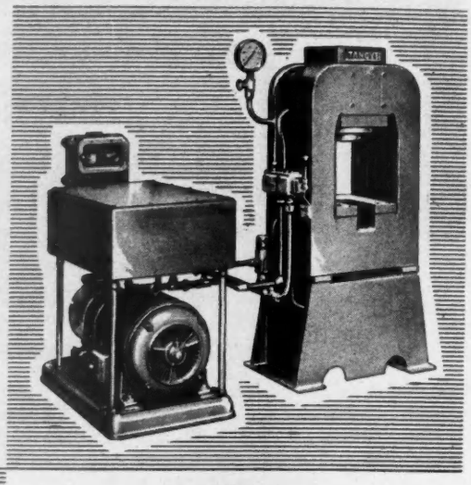
Large pipes requiring pressure testing are clamped between two rubber-faced plates and are filled with water by either a gravity feed or by a Tangye centrifugal pump. Pressure build up is then achieved by a Tangye hydraulic hand-pump.

The view below is reproduced by kind permission of NORCON LTD., in whose test house Tangye equipment is well in evidence.



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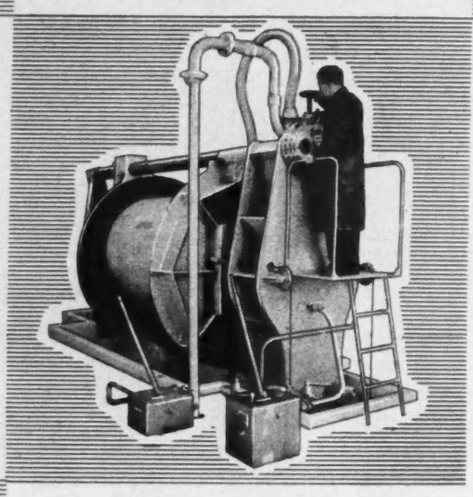

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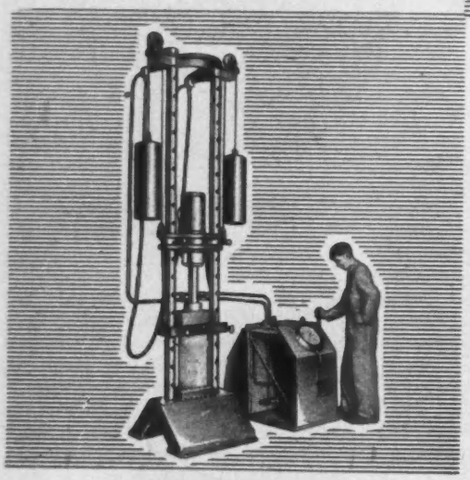
This neat and compact inverted press is 100 tons capacity. The table size is 15in. by 16in. with 15in. daylight. The 8in. diameter ram has a stroke of 5in. A number of these presses are in use pressing watch cases.



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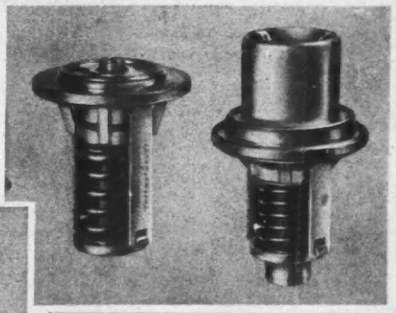

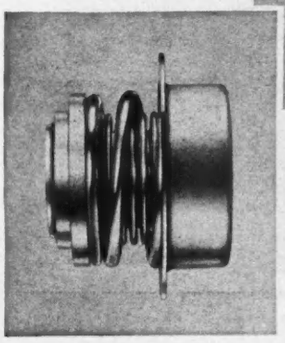

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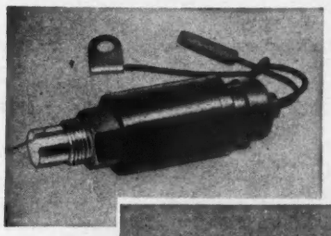
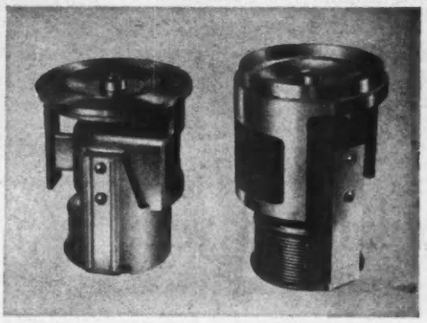
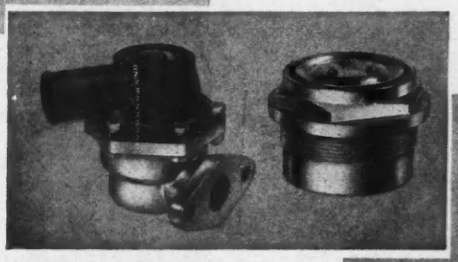




ENGINE COOLANT THERMOSTATS



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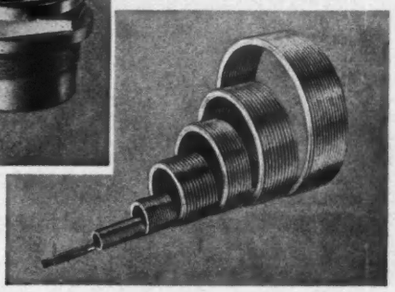

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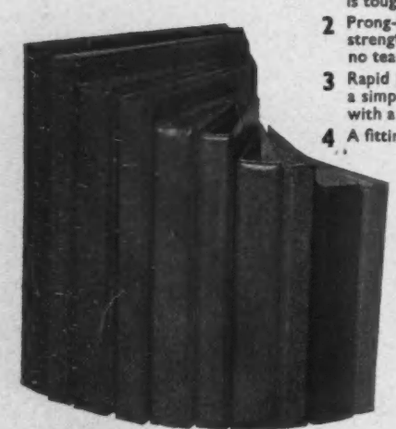

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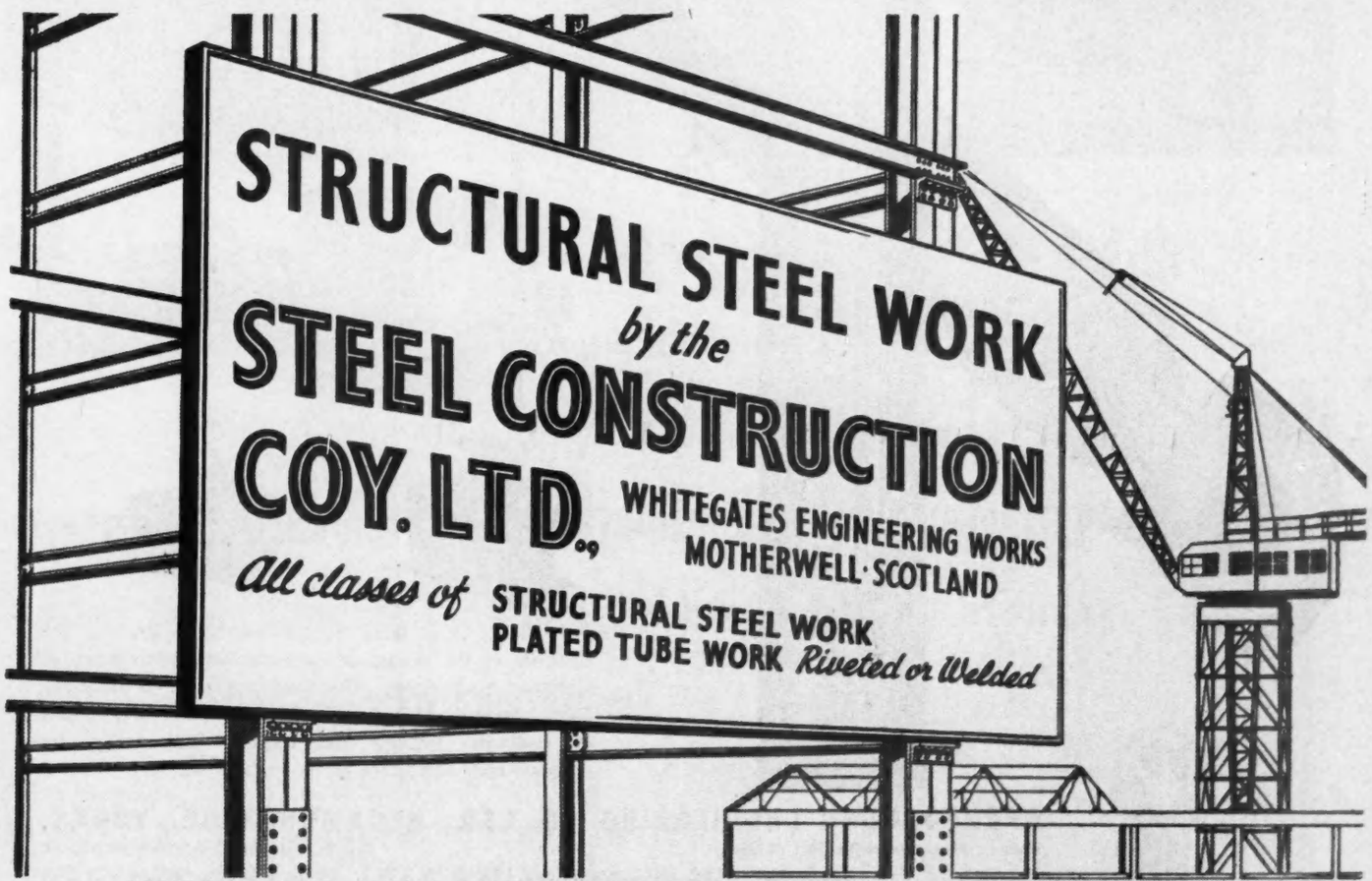

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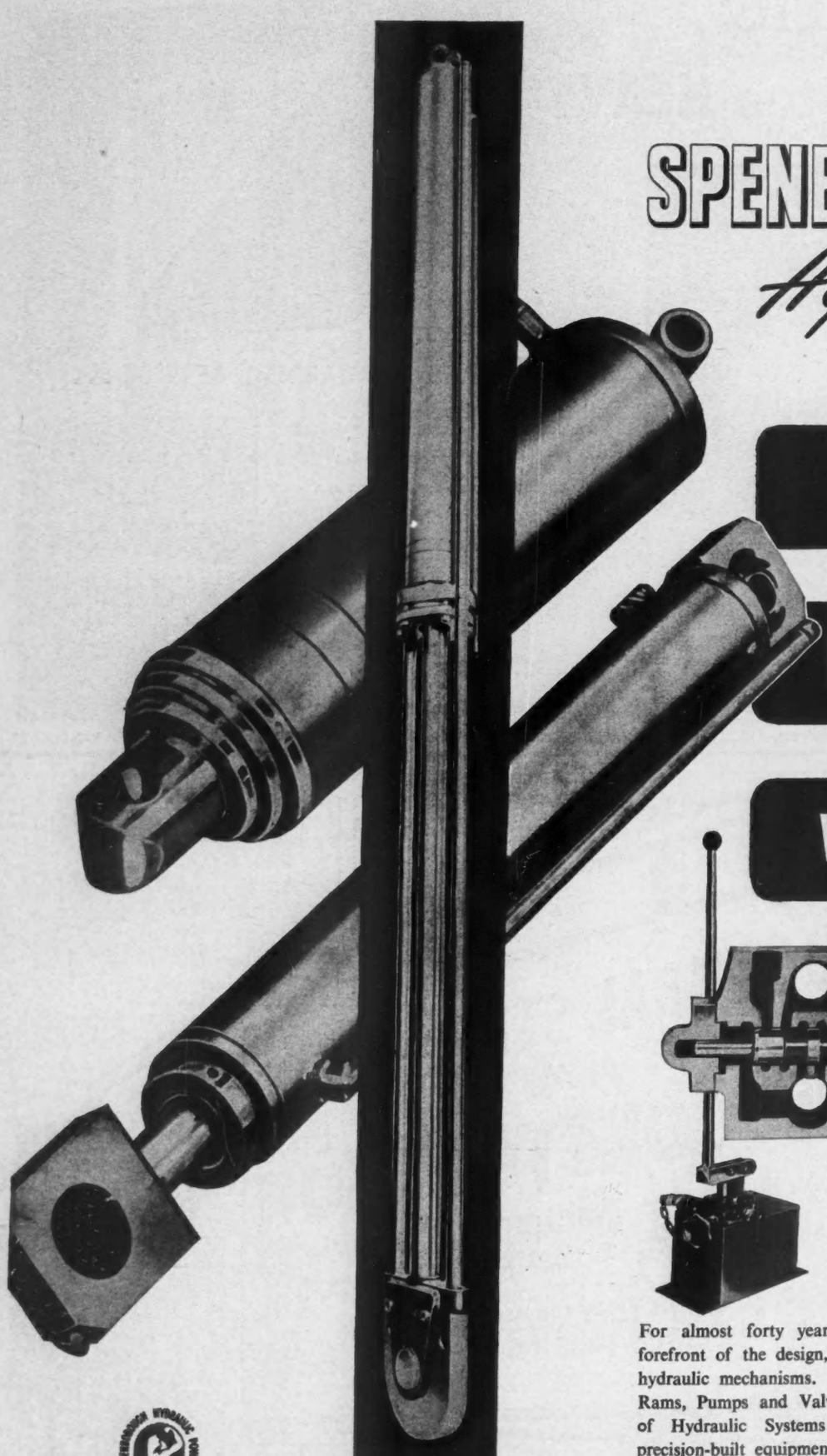
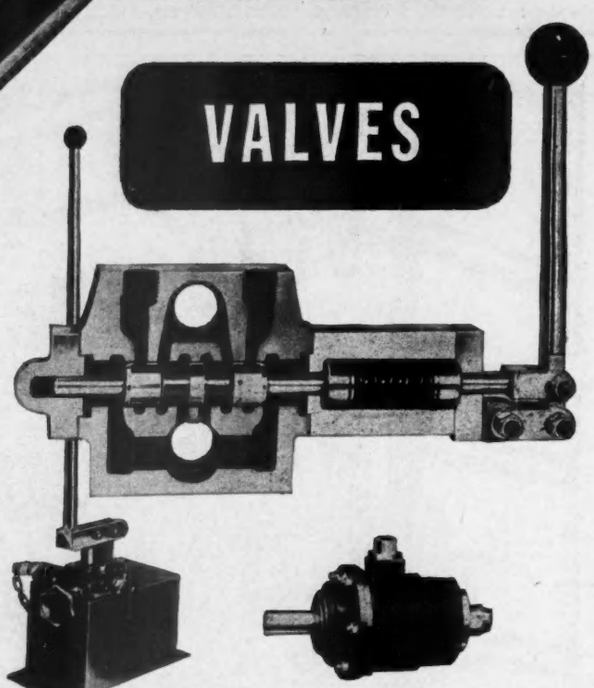


RAMS

PUMPS

VALVES



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LOST

On or about April 1st this year, between Lombard Street and the Metropolitan Police Boundary, a large quantity of Treasury Notes, Bonds, Sleep, Hope etc. by a Firm who forgot that **ASSOCIATED LEAD** supply: **RED LEAD PAINTS AND 'RUSTODIAN' CALCIUM PLUMBATE PAINTS** as well as every other form of Lead and Antimony, in any quantity. Firm concerned prefers to remain anonymous.

This announcement is issued for and on behalf of

ASSOCIATED LEAD MANUFACTURERS LIMITED

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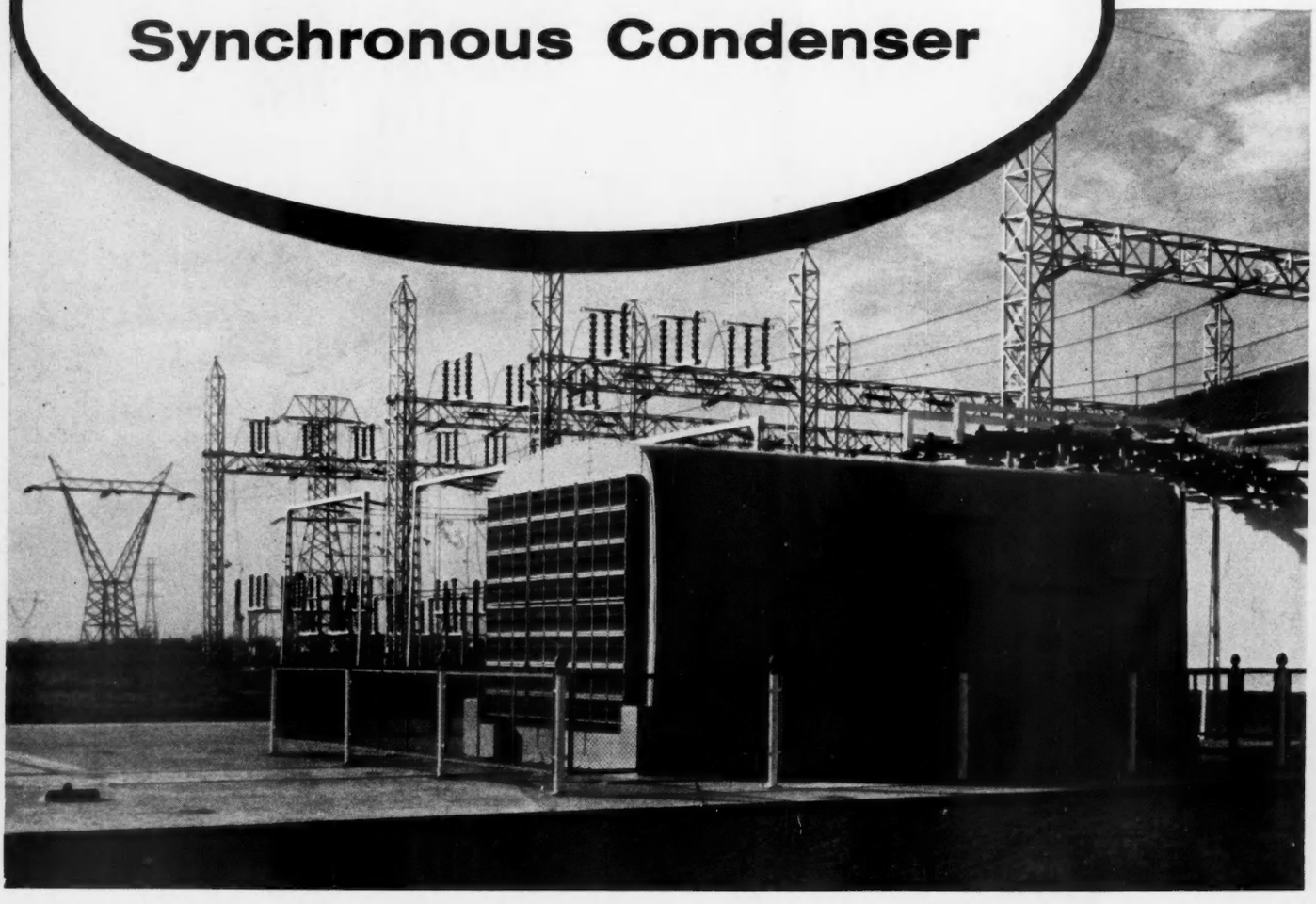
AEI 125-ton Synchronous Condenser



... erected with a 5-ton crane

This air-cooled outdoor-type AEI synchronous condenser, rated at 50,000 kVA 1,000 r.p.m., is in service at the Torrente (Spain) substation of Hidroeléctrica Española S.A. Despite the large capacity of the machine, its design permitted erection without the use of a heavy crane, the only equipment necessary being jacks, rollers, and a 5-ton hoist.

AEI Synchronous Condensers are in service in every continent

Sizes range from 1,000 kVA upwards, and total capacity installed or on order exceeds 700,000 kVA.

Enquiries relating to synchronous condensers should be addressed to Large Electrical Machine Sales, Rugby

AEI

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